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'We Made One Mistake at Hog Island'

After Weeks of Harassment by Critics, Official Says Error Was Not in Faulty Plans, or Extravagance, But in Failure to Take Public Into Their Confidence

AMID the raucous clamor of the I-told-you-so critics, America's shipbuilding program is rushing along toward a successful and speedy achievement. Within the past few days, publicity has been given to the work already accomplished at the three big, new government yards. At Hog island, keels are being laid ahead of schedule. Ships are beginning to assume form at Bristol. The record is an index to the performances being carried on at the scores of smaller, less criticized, but fully as efficient, yards which have sprung into action along the shorelines of the oceans, lakes and gulf. The shipping board has just revealed that 200,000 tons of ships were delivered in January and February with an equal tonnage due for completion in March.

There's a Long, Long Trail A'Winding

The criticisms as well as the encouraging prospects for success are apparently essential to the American way of handling a big job. The trail from the inception of a plan to its performance is a familiar one—with numerous precedents against searching for short cuts. At the beginning, the public is treated to a succession of glowing comments based upon huge plants and organizations springing into being, always "overnight". Impatience arises during the prosaic work of actually building the plant—such as dynamiting for pile-driving—or building up an organization—such as meeting a 700 per cent labor turnover. Dissatisfaction thus greets the accomplishment of these jobs in six months rather than the usual twelve or eighteen.

Subsequently, the trail is well marked. Hints of needless delays and of huge profits, a congressional investigation, wide publicity for all forms of criticisms, testimony by voluntary advisers whose "warnings" went unheeded, rumors of impending arrests, sagging interest as the facts come to light for relegation to the inside pages of the newspapers, discovery that the work may be done sooner than promised, reappearance of tributes to American genius as finished products begin to appear, and, finally, after these devious wanderings, a record to which one can "point with pride".

The preceding observations arise from the unraveling of the Hog island mystery. With the hysteria dying away, the public is learning that those backing that project were trying to build ships and not to plunder the federal treasury.

At Hog island, the operators have been robbed of public approval owing to the repetition of the fatal error which did much to delay the country's rebirth as a maritime nation. That error is the failure to appreciate the importance of taking the public into their confidence.

What Caused the Hog Island "Scandal"

Read the comment of an official of the Hog island company on the day that the first public inspection of the work was permitted, with a consequent influx of representatives of the country's leading magazines and newspapers. This official said, "we only made one mistake. We ought to have done this months ago." Or recall the comments of the senators who visited the yard—comments ranging from moderated criticism to cordial approval. And then remember the disappearance of the Hog island "scandal" from the center of the stage. The events are closely related.

The moral is one which needs re-emphasis if the newly born interest in an American merchant marine is to be capitalized sufficiently to assure us maritime importance after the war. Shipbuilders and shipowners who have not learned the lesson must be taught the vital need of winning public support by encouraging public inspection of their acts.

Other lines of business endeavor have prospered immeasurably since their leaders fostered the modern policy of co-operation, of the free interchange of information regarding methods of manufacture, of carrying on your business in the open.

To win longevity, the reborn marine industry must follow suit.

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Will There Be Enough Ship Steel?

A Study of the Fabricated Ship Problem from the Steel Manufacturer's Standpoint—What the Shipbuilding Program Means in Steel

By E. C. Kreutzberg

A PROMINENT steel fabricator has stated that whereas in England modern building and structural operations were developed largely through experience gained in shipbuilding, this order has been exactly reversed in this country. Here standardized shipbuilding methods are being evolved through the instrumentality of the craftsmanship which years ago elevated bridge and structural fabricating to the level of a fine art. For years dreamed of by a few engineers whom old-line shipbuilders were inclined to look upon as visionaries, the standardized ship is the child of a dire emergency which it was impossible to meet by ordinary methods. As long as the United States remained a neutral observer of the war, stimulation of shipbuilding in this country was entirely a matter of private initiative. With our entrance into the war, the shipbuilding industry at once became one of the country's principal offensive and defensive arms, since it was clear that without an abundance of ships, we could transport neither troops nor supplies. As a result of this vital need, shipbuilding methods are being revolutionized. In fact, this industry, under the urge of war, is undergoing progress almost over night which it undoubtedly would have required many years of prewar conditions to develop.

What the Average Man Sees

Of the tremendous shipbuilding activity now vibrant throughout the country, participated in by hundreds of industries and thousands of workers, the average man sees only what is visible on the surface. Of the records which are broken daily in the construction of the vessels, and in the production of the materials entering into their construction, he has only a hazy idea. For instance, on Dec. 4, the Federal Shipbuilding Corp. laid its fifth keel at its yard near Newark, N. J., on a site which only some two months before, had been unoccupied meadow land. On Nov. 21, this company riveted into its initial hull the first plate rolled by the new Liberty mill of the Carnegie Steel Co. at the Homestead works, Pittsburgh. The Liberty mill, incidentally, is typical of the almost superhuman efforts the steel industry is making in its endeavor to sustain the shipbuilding program. When the construction of this mill was authorized on April 17, no pencil had been put to paper in making preliminary estimates or designs and no parts or supplementary machinery were available. By the employment of steam shovels for practically all excavating work; by the use of special trains for transporting parts which required attention at other plants, and through the patriotism of skilled workmen and office men who voluntarily gave up their Saturday half holidays, their Sundays and their evenings to do work which the scarcity of common labor otherwise would have greatly delayed, it was possible to rush the mill to completion in record time. In fact, it began actual production of plates for the government on Oct. 17.

The decision to carry out by far the major portion of our shipbuilding program in steel, meant not only the stimulation of every branch of the steel industry whose service is essential in this work, but the decision itself was made possible by the existing capacity and efficiency of the industry as a whole. That the steel industry's production will keep well in advance of shipbuilding requirements, appears certain.

For instance, a standard cargo carrier, 9000 tons deadweight, such as is being constructed by the Chester Shipbuilding Co., and the Merchant Shipbuilding Corp., requires 2123 net tons of plates, 771 tons of shapes and 93 tons of bars and miscellaneous steel, making a total of 2987 tons; in addition, some 145 tons of rivets are required. A 9400-ton deadweight vessel, of the type which is being built by the Federal Shipbuilding Corp., requires 2060 tons of plates, 900 tons of shapes and 22 tons of bars and miscellaneous steel, making a total of 2982 tons; in addition 143 tons of rivets are required. For a 5000-ton vessel, some 1700 tons of steel, not including the rivets, are required, with plates, shapes and bars in approximately the same ratio as for the larger vessels. As shown by these figures, the net tonnage of steel required per vessel, depending on the type, varies from 31 to 34 per cent of the figure representing the deadweight tonnage, the percentage increasing inversely as the size of the boat. For each deadweight ton of standardized steel shipping, therefore, approximately 687 pounds, or 0.3435 ton of steel are required, of which 65 to 68 per cent are plates, 24 to 29 per cent shapes, 3 per cent or less bars and miscellaneous steel, and 4 to 5 per cent rivets.

Huge Tonnage by March

Composite vessels, neglecting the rivets, bars, and miscellaneous steel, may be estimated as requiring per deadweight ton, 0.2246 tons of steel, of which 61 per cent are shapes and the remainder plates.

It is stated by authorities who have carefully analyzed the possibilities that by April or May steel shipbuilding will have developed to a point which will permit of the launching of 240,000 to 250,000 deadweight tons per month. It will not be until the fourth quarter of 1918 that our capacity will have increased to the rate of 6,000,000 tons annually. Launchings of new steel vessels during 1918, it now is calculated, will not be in excess of 3,400,000 deadweight tons. In addition to the steel

Ships to Win the War

LLOYD GEORGE says, "Ships will win the war." Ships to win the war are now being turned out in almost every port all around the coast from Maine to Washington, while on the Great Lakes one concern alone has contracts for 70 canal-size steamers for 1918 delivery. This tremendous program means much to the American steel industry. Will there be steel enough to go around? In this article Mr. Kreutzberg answers, "yes" emphatically, and tells you why. The American steel industry can carry the burden of war in ships, as well as in guns, munitions and countless other directions.

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vessels, it is likely that at least 150,000 deadweight tons of composite ships will be launched during 1918. It is on these figures that calculations of the amount of steel to be required in 1918 in carrying out the shipbuilding program must be based. For the steel vessels, approximately 1,168,000 net tons of steel will be required. For the composite vessels, approximately 33,700 tons of steel will be required. The total, therefore, is 1,201,700 tons, of which about 778,000 tons are plates and 330,000 tons shapes.

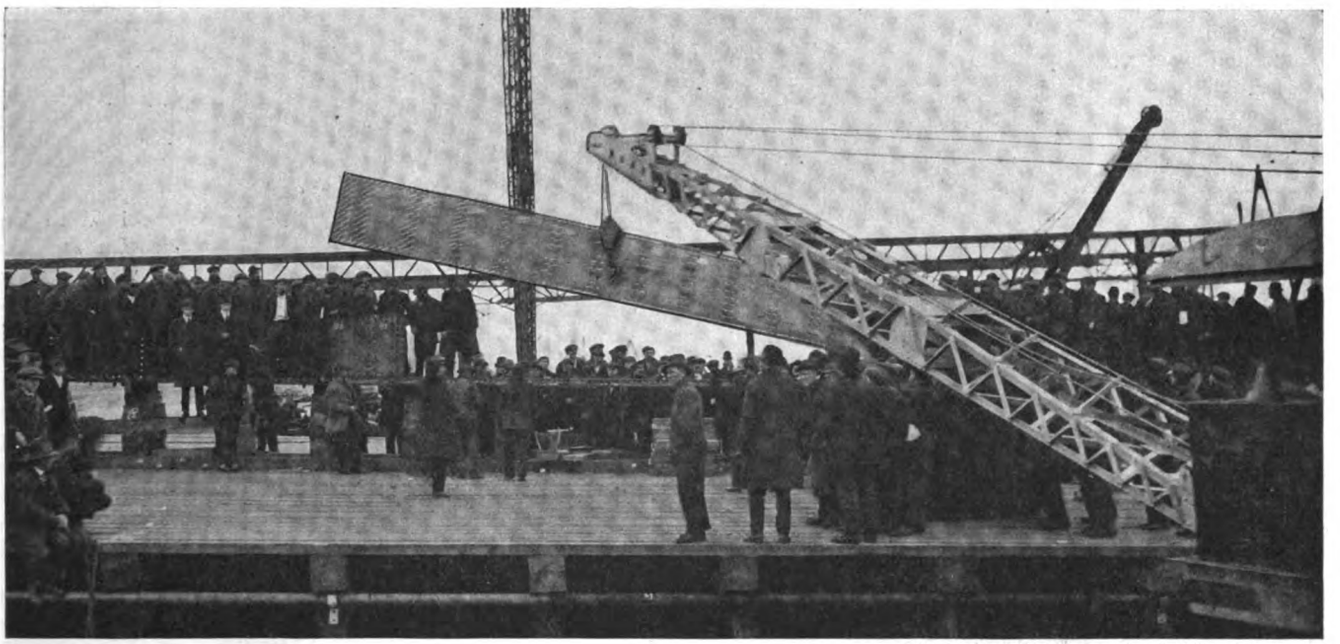
In sheared and universal plates in dimensions which are suitable for shipbuilding, the country's capacity now is at the rate of 2,800,000 to 3,000,000 tons, and it conservatively may be estimated by reason of new plate mills which are under construction, that by the fourth quarter of 1918, the capacity of such plates will be between 3,500,000 and 3,600,000 tons. After deducting 778,000 tons as representing the requirements for our merchant shipbuilding program during 1918, at least 2,400,000 tons of such plates will be left out of the 1918 production to take care of other demand. Large quantities will be required for various military requirements of the United States, such as the construction of cars, locomotives, tanks, trench bombs, etc., and it is likely that our active allies will endeavor to secure at least 1,000,000 tons of ship plates here during 1918. Therefore, while the fulfillment of the shipbuilding program will require a much smaller percentage of the output than has been expected, war requirements generally, according to well informed estimates, will account for fully 75 per cent of the output of plates suitable for shipbuilding. Incidentally, the plate output which reasonably can be expected during the next twelve months, would be sufficient, were it devoted exclusively to shipbuilding, for the creation of more than 14,000,000 deadweight tons.

Three Kinds of Shipbuilders

Standardized and fabricated are entirely synonymous terms when applied to the majority of vessels now being built for the government. The essential feature of standardization is the adoption of designs which eliminate curves wherever possible, thus enabling fabricating shops to furnish the larger portion of the hull steel. The ideal condition in standardization is found where shipyards, like the American International Shipbuilding Corp. and the Submarine Boat Corp. devote themselves entirely to assembling fabricated steel into complete vessels. So far this state of advancement has not entirely passed the period of organization. Shipyards in this country now fall into three clearly defined groups. The first includes established shipbuilding plants which have their own facilities for completely fabricating the plates and shapes needed. These plants are dependent on the steel industry only for plain material as it comes from the mills. The second group includes yards such as those of the Chester Shipbuilding Co., the Federal Shipbuilding Corp., the Merchant Shipbuilding Corp. and the Newburgh Shipyards, which have their own facilities for fabricating the bow and stern sections and other parts which have to be warped or where the opening or closing of angles is necessary. These yards rely on outside fabricating plants for other fabricating work, which constitutes all the way up to 88 per cent of the steel required for the vessels they are building. The third group of shipbuilders, already alluded to, embraces purely assembling organizations depending on outside shops for all of the steel required.

At least some or all of the fabricators who furnish material to the third group must be provided with all of the equipment necessary for handling this steel. The tools that are required include single and multiple punches, plate planers, shears, beveling shears, scarfing machines, drilling, reaming and countersinking apparatus, while for curved work, bending rolls and presses, and bending slabs for bending the flanges of channels and angles. Also for bending plates for the bow and stern, presses for bending shapes, special heating furnaces, etc., are needed. Only a few of the best equipped shops so far have undertaken the curved work.

The principal tool employed in fabricating ship steel, in fact, the tool which old-line shipbuilders regarded as practically valueless for their work, but which has proved a major factor in making the present speeding-up process possible, is the multiple punch. An idea of the punching which is necessary is conveyed in a recent statement by Homer L. Ferguson that a 7500-ton fabricated ship requires about 650,000 rivets, which means at least 1,300,000 holes for rivets alone. The multiple punch



Photograph by International Film Service

LAYING THE KEEL FOR A STANDARDIZED STEEL SHIP

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does in a moment what would require minutes with the single punch. By adapting the spacing of holes to the same multiple, the punch spindles can be set permanently and after that it simply is a matter of constant repetition of the same operation. When the holes are too close together to be punched at one stroke, the spacing is arranged so that an additional stroke will suffice.

The difficulties encountered in the construction of the fabricated vessels result almost entirely from the lack of familiarity with such work which is prevalent outside of shipbuilding establishments. It is contended that any shop which can fabricate bridge and structural steel can concentrate its activities on the fabrication of ship steel. This contention appears to be well founded, since fabricating shops which only a few weeks ago accepted contracts for ship work with a good deal of apprehension are finding it to be less difficult than they anticipated. The extent to which fabricators may participate in shipbuilding is shown by the fact that in some cases they have even their own mold lofts for laying out hulls completely or in parts, in order to make their own drawings and templates. The present bridge and structural shop capacity of this country is rated at 180,000 tons per month, or 2,160,000 tons per year. This figure is equivalent roughly to some 6,288,000 deadweight tons of shipping. Considering the steel which will be fabricated at the self-contained and partly self-contained shipyards, the fabricators will probably have a comparatively easy time of it.

In brief, the great iron and steel industry of the United States is already organized and equipped to meet any demands our war shipbuilding program may require.

The new motorship SANTA ISABEL, of the fleet of W. R. Grace & Co., has had her machinery installed at the Union Iron Works, San Francisco. The SANTA ISABEL was built at Aberdeen, Wash.

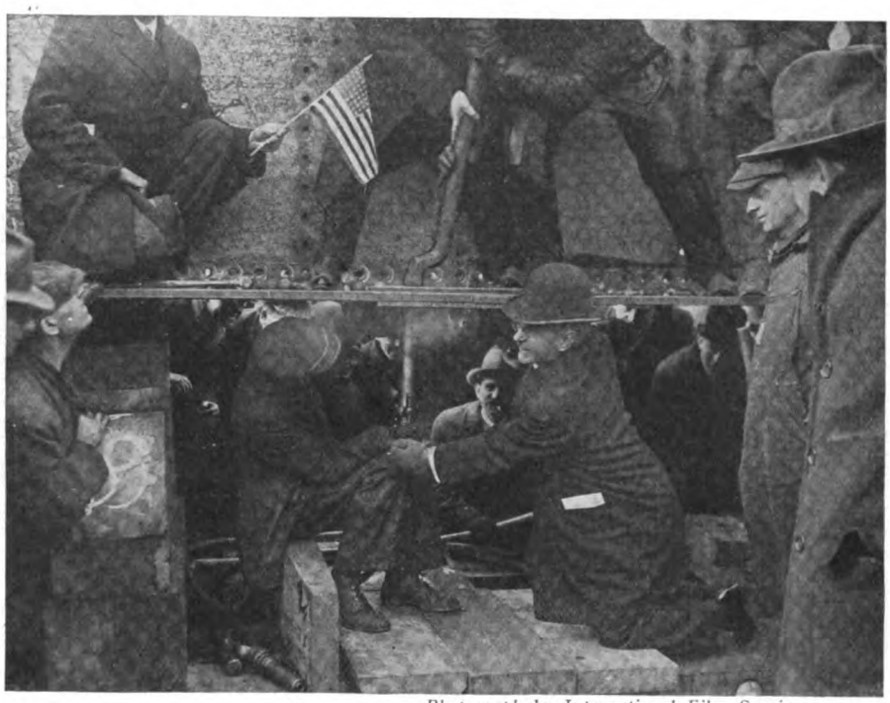
Receives Cane Made From Old Wreck

A cane made from the wood and copper salvaged July 17, 1917, from the PEWABIC, has been presented to Capt. George P. McKay, Cleveland, who was master of the vessel. Captain McKay is treasurer of the Lake Carriers' association. The PEWABIC was sunk Aug. 9, 1865, in Lake Huron, when carrying copper. Salvaging operations last year recovered part of the cargo. J. S. Moffat, collector of customs, Alpena, Mich., in presenting the cane, wrote as follows:

"Your letter of Feb. 25, 1918, duly received, with information asked for regarding your home address and your kind acceptance of my offer to present you with a souvenir walking cane made from the oak timbers which I secured from part of the hull of the ill-fated steamer PEWABIC. The copper imbedded in the top of the cane I secured from part of the cargo of copper, salvaged by the Leavitt Wrecking Co.

"Accepting an invitation from F. Earmish, the wrecking master, Aug. 6, 1917, myself and several other Alpena people, made the trip to the wreck. Some of the party you may remember as Capt. John D. Persons, whose father was keeper of the Thunder Bay island life-saving station at the time of the sinking of the PEWABIC, and two daughters of W. B. Comstock, one of Alpena's lumbermen, living in Alpena at that time.

"We left Alpena on the morning of Aug. 6, on the little tug GRAYLING, and soon arrived at the scene of the wreck, which is about 17 miles straight out from Alpena as the arrow would point. It was our good fortune to be present when the biggest lift of copper taken in one day was taken from the wreck. It was an inspiring sight to see the great crane swing over the side of the wrecking scow it was attached to and drop the big steel clamps down on the wreck, at a depth of 28 fathoms, and bring up pure copper bars, all stamped with the name of the company that made them, shining as bright as the day they went down. We also had an exciting event when the great crane brought to the surface two large blocks of copper, one piece weighing 9678 pounds. The great clamps had just a slight hold on the big chunk of copper and in raising it up the rope cable became twisted, and it looked as if the slight hold the clamps had would not hold to land it. On the scow it was necessary for the operator of the crane to untwist the cable before it could be landed. You may imagine our anxiety and excitement, everybody looking with strained eyes, each moment expecting it to slip out and back into the water again. But luck was with us and the great mass was landed safely on the deck of the wrecking scow. Then a mighty cheer went up from each one present, which drew the crews of passing vessels to the sides of their vessels to find out what had happened. As you are aware, the wreck of the PEWABIC lies directly in the course of steamers.



Photograph by International Film Service

DRIVING THE FIRST RIVET IN A STANDARDIZED STEEL CARGO CARRIER

"I assure you it was a day of great suspense and excitement for all of our party, never to be forgotten. Think of it, the oak and copper from which the cane is made has been submerged for 52 years on the bottom of Lake Huron, in 28 fathoms of water, so I offer you this small souvenir token as something you may cherish, and your children and your children's children may cherish, as a remembrance of you as master of this historic vessel. I have mailed the cane by parcel post to your Cleveland address and I trust that you will receive it in good order."

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The Ship That Foundered Herself

Plan of Shipping Board to Equip Sailing Vessels With Engines for War Service Generally Approved—Discrimination Necessary in Selecting Hulls

THESE days of patriotic impulses heap the desks of the shipping board with suggestions for defeating Germany's attacks on our merchantmen. If each could fulfill its author's claims, the board's problem of building up a worthy merchant marine would be greatly simplified; in fact, the submarines would be overwhelmed by numbers alone. Mr. Hurley and his associates are encouraged by the co-operation shown in these thoughtful contributions to the text-book of maritime defense. Most of the suggestions are constructive; some have undoubted merit and often solve problems which have been encountered in the development of important plans.

The board also receives criticisms of the projects it has adopted. One in particular has drawn journalistic fire—the plan of supplementing our fleet of steel ships with power-driven schooners, created by fitting new engines to superannuated hulls. A number of old sailing vessels are being stripped of spars and invested with twin screws and entirely new identities. This seems to be a rational undertaking which should make a valuable contribution to our shipping facilities—one not to be disregarded while the labor and traffic situations play havoc with the construction of our steel ships.

Ship Built to Sail

However, there is some danger of carrying the thing too far—of installing machinery in hulls that are too infirm to warrant such an expenditure. The selection of ships should be made conservatively if the project is to succeed; otherwise we both destroy the ships and defeat the plan.

The *Philadelphia Public Ledger* recently published an article by Lincoln Colcord, which is an interesting comment on this possibility.

This is not the story of a new ship on her maiden voyage getting her first shaking down. It is the story, rather, of an old and wise ship sent out by landlubbers to do the impossible.

She had been built to sail, and she had sailed. Long ago she had taken her maiden voyage, met the elements, strained and groaned in every part, and eased herself at last to the free life of wind and wave.

She had now reached a comfortable and efficient maturity. She had weathered many a gale; she had learned the worst that the elements could bring against her; she had tested her capabilities to the full. She felt with excellent justification that she knew her business, and that they knew their business. She felt that she was doing good work; that she was a factor in ocean transportation.

"What Now?" Asks the Rudder

One day they hauled her out on a certain marine railway and a big gang of men began unhanging her rudder.

"Here, what's the matter?" said the rudder to the sternpost. "There's nothing wrong with me. What are they doing this for?"

"Don't ask me," answered the sternpost. "Times aren't what they used to be. They do anything to a sailing ship nowadays."

"They can't be going to cut her down for a barge," growled the rudder. "She'd need me even if she were a barge. Here, you idiots, let up on that. I've steered this ship through three typhoons and a West Injie hurricane, and I propose to stick by her as long as she's afloat."

A couple of men in top hats had entered the yard and stood beneath the vessel's stern watching the proceedings. The foreman of the yard came up to them.

"Why doesn't it lift out?" asked one of the top-hatted strangers.

"What, the rudder? It's been hung there a long time and done a lot o' service," answered the foreman. "It doesn't want to come."

"You persons who work about ships are always so amusing," remarked the other top hat. "You speak as if the parts of a ship, and the ship itself, were alive."

"The ship *herself* you mean," said the foreman. "I never yet have known a ship that was an 'it'. The 'its' are the landlubbers who play with 'em." He moved away.

"Curious fellow," commented one top hat to the other. "They're all that way; but now to business. Here we stand facing the first experiment in line with our great idea. Very shortly this fine ship will be driven by twin screws across the ocean. No longer will she have to depend upon her silly sail power, a survival of the dark ages of transportation. She shall have *steam!* She is the forerunner of a fleet of 1,500,000 tons of sailing ships, all of which shall be fitted with twin screws, and Germany will tremble, recognizing in this her Nemesis, the defeat of her submarine campaign."

"Did you hear what they said?" whispered the rudder to the sternpost. "They're going to put steam into her. They're going to fit her with twin screws! What next? I want to get out of her if she's going to have twin screws. Here I've been steering her for years in sweet open water, and now they want to put a couple of whirling, churning gewgaws on either side o' me. Oh, it's enough to break a good rudder's heart."

"Well, what do you think of me?" muttered the sternpost. "I've got to take it whether or no. Twin screws—just imagine!"

The word had passed by this time up into the vessel and every part of her joined the general conversation.

The Garboard Strake Joins In

"Twin screws!" The hoarse bass of the garboard strake sounded above the clamor. "That means *engines,* and that means bunkers. Bunkers I can hold, but engines I wasn't made for."

"Neither was I," boomed the keelson. "Twin screws means a lot of engines. Say, what gang of confounded landlubbers has got hold of us, anyway?"

A great stillness fell on the ship, while all her parts were thinking. Then from aloft the masts and yards spoke solemnly:

"Listen, brothers; if all this talk of steam be true, we are to be the sacrifice. We, the skypointing spars with lifting sails, the pride and glory of an outworn day. There be men of the sea and men of the land. Brothers, men of the sea would never have done this thing. But ships have passed into the hands of men of the land. That is the answer, and there is nothing that we or ye can do. Then let us bow our heads to fate, as we have learned from life and as the men of the sea are accustomed to do."

"Good words and brave words, brothers aloft!" boomed the keelson. "But if you pass, I think you go only a little while before us. There is doom for all of us in this news."

"We are expected to save democracy!" shouted the rudder. "That is the bitter thing. They, not knowing, will blame us when we fail."

"That, too, is fate," answered the lofty topgallant and royal masts.

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Where to Recruit Shipyard Labor

First Complete Analysis of the Shipyard Trades Showing How Kindred Trades Can Supply Men Who Are Already Skilled Along Similar Lines

THE program of the United States shipping board and Emergency Fleet corporation calls for the delivery of a heavy tonnage of shipping during 1918. To carry out this program requires the recruiting of approximately 150,000 men for shipbuilding. These men can rapidly gain experience in the shipyards, but they cannot secure the necessary skill and knowledge in the short time available. It follows naturally that the men to be secured in this emergency are those whose previous training has given them some of the skill and knowledge required for a shipbuilding trade or for some special work in that trade.

The problem of training shipyard workers has been taken up by the United States shipping board and the Emergency Fleet corporation under the direction and supervision of its industrial training section. Training departments are being established in every shipyard that is building ships for the Emergency Fleet corporation. Each of these training departments is in charge of a director and has an instructing staff drawn from the shipbuilding industry.

To Train Craftsmen

The analysis of the shipbuilding and kindred trades, shown in Table I, has been made by the federal board for vocational education in order to assist instructors and students in schools and classes designed to train craftsmen for the emergency shipbuilding program. The summary may be of assistance to employment agencies and others interested in recruiting men for shipbuilding.

For purposes of comparison with outside trades, the shipbuilding trades are divided into three classes:

1—Shipbuilding trades in which there is no corresponding outside trade, but for which experience in certain kindred trades is an asset.

2—Shipbuilding trades in which there is a corresponding outside trade, but for which additional special training is necessary for satisfactory work in shipbuilding.

3—Shipbuilding trades into which the outside craftsman may come without additional special training.

The ship trades in which there is no corresponding outside trade are the following: Mold loftsman, shipwright or ship carpenter, ship fitter, wood calker, sailmaker, plate and shape furnace man, anglesmith and rigger.

The mold loftsman, or loftsman as he is often called, is a combination of draftsman and template maker on steel shipwork (see Table II). In his drafting work three plans are used: The sheer, half-breadth and body plans corresponding to the side, top and end views commonly used in drafting. The body plan is drawn upon the floor full-size while the sheer and half-breadth plans are usually drawn to a large scale on a drafting table. From these plans and from drawings, the full-size layouts of the various parts of the ship are made on the floor. Templates or molds, which are wooden or paper patterns, are then made to conform to these layouts and from them the shapes and plates for the ship are marked for fabrication by the ship fitters. The most difficult work in the mold loft is that of the linesman, and this is usually done by one or two special men. It is their duty to pencil or "fair" the body plan upon the floor, and in some cases to draw the sheer and half-breadth plans from which important measurements are taken. It is also their duty to do the most difficult laying out, particularly that requiring a knowledge of development. The less difficult parts are laid out by the regular loftsmen who may also make the necessary wooden templates. These are sometimes made by special workmen known as mold makers.

The mold makers merely make the template to conform to the lines laid out for them and need not necessarily have any knowledge of ship construction.

Craftsman Must Plan Carefully

Every craftsman needs one or all of three kinds of skill: Planning skill, assembling skill, or fabricating skill. A loftsman is pre-eminently a planner, not an assembler or a fabricator. He must be able accurately to read blueprints of a complicated nature and clearly to visualize the relation of the various parts indicated. He must be able in addition to measure and lay out accurately from drawings and have a knowledge of the form, location, and use of the various parts of the ship. From the work of the linesman, he must have a knowledge of drawing and developments and a special acquaintance with ship construction. Men for the mold loft trade must be drawn from trades in which planning skill in structural work is a chief requirement (see Table IV). If a man is employed simply as a template maker, skill with woodworking tools is the only essential. Men in the following trades possess skill and knowledge which is of assistance in mold-loft work: Structural template maker, structural marker or layer out, sheet-metal worker, house carpenter, cabinetmaker, naval draftsman; structural, architectural or mechanical draftsman; and patternmaker.

Some loftsmen are of the opinion that draftsmen are not successful in loft work due to the fact that they are accustomed to work on a small scale and are unfamiliar with tools. Others have been very successful in training draftsmen after they have become somewhat accustomed to ship blueprints.

The work of the shipwright is the most varied of any of the shipbuilding trades (see Table V). He follows closely and plays a part in the construction of the ship from the laying of the keel blocks until the vessel slides into the

To Train Workers

IN the history of the world, shipyard workers have never been needed as imperatively as in the United States at the present time. With many skilled workmen required to build one ship, it follows that a host of workers is necessary to turn out the vast armada which is to be launched during the present year—600,000 men is the maximum estimated. But prior to the present expansion, the shipbuilding trades in this country were fast becoming lost arts so that the problem of finding workmen has been one of the most serious which the United States shipping board and the Emergency Fleet corporation has had to surmount. To train the men, schools are being established in every shipyard where ships are being built for the Emergency Fleet corporation. Here, men who possess the necessary qualifications to fit them for a shipyard trade, through working at a similar trade, are trained to perform their new duties under competent instructors. The accompanying article and charts were adapted from a bulletin on "Emergency Training in Shipbuilding", issued by the federal board for vocational education at the request of the shipping board and the Emergency Fleet corporation. Large copies of the charts may be obtained from the federal board.

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water. The work may be roughly divided into two classes—the carpentry or woodwork, such as the building of scaffolding, building cradle and launching ways, laying wood decks, installing ceiling, etc., and the erecting or millwright work, such as horning bulkheads, lining and installing stem and stern posts, laying off for and installing deck fittings, fairing frames and keeping ship fair upon the ways. The first class of work calls for the fabricating skill and knowledge of woodworking tools possessed by the carpenter; the second for the planning and assembling skill of the millwright and erecting man.

Spar making, boat building and calking wood decks are special classes of shipwright work and are done by special gangs or special men. Inside work, such as the building of stairs, cases, cupboards, berths, and paneling, commonly known as interior finish, is not done by the shipwright but by the ship joiner.

A shipwright is primarily a planner and assembler, and in certain forms of work, such as spar making and boat building, a skilled fabricator. He must be particularly able in keeping the ship and various parts of the ship properly lined, squared and plumbed. Aside from this, he must have a practical knowledge of timbers and of proper methods of blocking, shoring and stage building, with particular application to the construction of the launching cradle and launching ways. For this work he needs a knowledge of, as well as skill in, using carpenter's tools on heavy work and, in addition, some skill with the broadax and adze. It is desirable, but

Table I

A Summary of Shipbuilding and Kindred Trades

Trades outside of shipyards.	Shipyard trades in which these craftsmen may be used.
Architectural iron worker	Anglesmith.
Asbestos workers	Pipe coverers.
Auto repair man	Ship fitter. Outside machinist.
Blacksmiths:	Blacksmith.
Railroad blacksmiths	Hammer men.
Machine blacksmiths	Tool dressers.
Hammer men	Shipsmiths.
Tool dressers	Anglesmiths.
	Plate and shape furnace men.
	Ship fitters.
Boiler maker	Boiler maker. Ship fitter. Flange turner.
Bricklayer	Pipe coverer. Cementer.
Bucker-up. (See Riveter.)	
Cabinetmaker	Joiner. Template maker.
Carpenter	Ship carpenter (shipwright). Ship joiner (if he has had experience on inside work). Mold loftsman. Ship fitter.
Carvers	Carving (in joiner shop).
Carriage smith	Blacksmith.
Wagon smith	Anglesmith.
Wheelwright	Plate and shape furnaceman. Ship fitter.
Chipper	Chipper (in foundry). Chipper (in yard and on ship). Calker (steel). Riveter.
Concrete man	Cementer. Pipe coverer.
Core maker	Core maker.
Coppersmith	Coppersmith.
Dock builders	Ship carpenters (stage builders).
Drop forger	Drop forger.
Engineers, steam	Outside machinists (if they have had erecting or repair experience). Pipe fitters.
Erecting engineer or road man	Outside machinist. Shipwright.
Elevator Constructor	Outside machinist. Shipwright.
Electrical workers:	
(a) Outside man	Outside wireman in yard.
(b) Inside wireman	Wireman on ship.
(c) Telephone installer	Wiring on intercommunicating systems.
(d) Wire chief	
(e) Trouble shooter	
(f) Switchboard man	
(g) Motor repair man	Motor repairer and installer.
(h) Armature winder	Armature winder.
Galvanizer	Galvanizer.
Gasfitter. (See Pipefitter.)	
Granite cutters	Chipper and calkers.
Stone cutters	
Quarrymen	Drillers and reamers.
Heater. (See Riveter.)	
Horseshoers	Blacksmith. Anglesmith. Plate and shape furnaceman (or helpers). Ship fitter.
House mover	Shipwright.
Lumber jacks	Ship carpenters. Lumber handlers and stage builders.
Machinists	Floor hands. Bench hands. Machine hands. Machine operators. Outside machinists.
Molders	Molders of all kinds. Green sand, dry sand, bench, side floor and floor, cast iron, steel, and brass
Ornamental iron worker	Anglesmith.
Painter	Painter.
Pipe fitters:	
Steam fitter	Pipe fitters.
Gas fitter	
Pile-driver man	Shipwright.
Plumbers	Plumbers.
Painters	Painters (wood and metal).
Passer. (See Riveter.)	
Plasterers	Pipe coverers, cementers.
Quarrymen. (See Granite cutters.)	
Riggers	Yard riggers. Bolter-up.
Riveters:	
Structural	Riveters.
Tank	
Automobile	
Bucker-ups	Holder-ons.
Passers, heaters	Passers, heaters.
Sailors	Rigger (in rigging loft).
Steam fitter (See Pipe fitter.)	
Structural iron workers:	
(a) Structural marker	Ship fitter. Loftsman.
(b) Structural fitter	Assembler or bolter-up. Ship fitter. Loftsman.
(c) Structural liner or regulator	Shipwright. Assembler. Ship fitter.
(d) Structural erector	Assembler or bolter-up. Ship fitter. Shipwright. Riveter.
(e) Structural template maker	Template maker. Loftsman.
(f) Structural draftsman	Draftsman. Mold loftsman. Ship fitter.
(g) Structural yard man	Material man. Cold sawyer. Yard man.
Sheet-metal worker	Sheet-metal worker. Ship fitter. Mold loftsman.
Tent and awning maker	Sailmaker.
Wagonsmith. (See Carriagesmith.)	
Wheelwright. (See Carriagesmith.)	
Wood finisher	Wood finisher.

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Table II

Analysis of the Mold Loftsman's Trade

Classes of work done.	Men required for each class.	Individual duties.	Jobs done.	Analysis of operations.
Lines	One linesman works alone or with 1 to 2 helpers or apprentices	Makes measurements and lays off lines on floor. Hold chalk line, hand linesman tools, and assist linesman as directed. NOTE.—Linesman is the highest grade of loftsman and may be called on to perform any class of mold loft work.	Draws sheer plan. Draws half-breadth plan. Draws body plan. Does most difficult laying out, especially jobs requiring knowledge of development and lifting of bevels.	1. Gets sheer, half-breadth, and body plans together with tables of offsets furnished by drafting room. 2. Draws half-breadth and sheer plans to large scale on large table or mold loft floor. 3. Corrects offset tables from this large-scale drawing. 4. Returns corrected tables to drafting room. 5. Pencils full-size body plan on freshly painted space on mold loft floor. This plan includes water lines, frame lines, etc. All necessary information for laying out any part of the vessel, such as shape of frames, floor heights, position of decks, stringers, longitudinals, shell plate edges, etc., may be obtained from it. 6. Furnishes pattern shop with necessary information on stern post, stem, hawse pipe, etc.
Frames	2 loftsmen 2 helpers or apprentices	Make measurements and lay off frames on floor. Hold chalk line, bore holes, paint symbols, tack templates, assist loftsman in general, and may lay off simple straight molds.	Lay out templates for— Frames, cant and square. Stringers. Longitudinals. Stanchions. Side frames. Bottom frames. Deck beams. Brackets. Clips. Angles. Build small templates. Furnish layout to template maker for large frames.	1. Get template from stock or fair lines on floor for template to be built. 2. Fair template with lines on body plan. 3. Lay out and mark rivet holes according to standard tables. 4. Bore rivet hole in template. 5. Mark upon template number of pieces, position, frame number, boat number, and other necessary information for fabrication.
Decks and inner bottoms.	1 loftsman 1 helper or apprentice	Makes measurements and lays off decks and inner bottom on floor. As above.	Lays out paper and wood templates for deck and inner bottom.	1. Lays out deck plan on mold loft floor showing position of butts and seams and all openings such as hatches, engine casings, etc. 2. Gets template from stock or makes new template to fit layout. 3. Indicates rivet holes by— (*a*) Boring holes in wood template. (*b*) Prick punching paper template.
Shells	2 loftsmen 2 helpers or apprentices	Make measurements and lay off shell plates. As above.	Lay out templates for all shell plating except special shaped plates and closing strakes which are lifted from ship by shipfitters.	*See* Deck and inner bottom analysis.
Bulkheads	4 loftsmen 4 helpers or apprentices	Make templates for all bulkhead plates and shapes. As above.	Lay out templates for all bulkheads and necessary angles, straps, plates, collars, staples, etc.	*See* Deck and inner bottom analysis.
Miscellaneous	1 to 6 loftsmen 1 to 6 helpers or apprentices.	Lay out and make small templates for miscellaneous parts. As above.	Lay out templates for foundations, fresh-water tanks, masts, vents, etc.	*See* Deck and inner bottom analysis

Table III

Comparison of Shipwright and Kindred Trades Involving Erecting Skill

Trade names.	Work done.		Comparisons.		Assets of man in kindred trade.	What he must be taught.
	Shipwright.	Kindred trade.	Shipwright.	Kindred trade.		
Millwright, erecting engineer or erecting man, outside machinist or road man, elevator constructor or erector.	The shipwright aside from the work done by him similar to that of the house carpenter does other entirely different work similar to that of the millwright or erecting man. This may be briefly described as lining and installing.	The millwright or erecting man is chiefly concerned with the proper erection of buildings and the installation and erection of all kinds of machinery. He is familiar with the processes of laying off for, lining up and erecting machinery, shafting, and all forms of mechanical equipment.	In general the same processes of lining and erecting are used by the shipwright and men from the kindred trades. The millwright is familiar with the erection of machinery and buildings, the structural liner with plumbing and squaring steel structures, the erecting or road man with special types of machinery, and the elevator man with elevators, pumps, motors, escalator machinery and equipment. All are accustomed to lining and squaring and the use of the level and plumb bob. All of them except the structural liner have more experience with machinery than is necessary for the work of the shipwright.	(1) Knowledge of lines and processes of lining and squaring. (2) Realization of the need of accuracy. (3) Ability to measure accurately. (4) Ability to read blue prints (5) Knowledge of and skill with ordinary hand tools. (6) Ingenuity or ability to do a job in the best way under given circumstances. (7) (Usually.) Varied experience. (8) Self-confidence and sense of responsibility. A good man with mechanical ability and good judgment should quickly learn to do this work. In many cases in this work the shipwright works in conjunction with the engineers and machinists. NOTE.—An erecting engineer on steam engines turbines, blowers, and pumps is particularly adapted to the work of the outside machinist on the main engines and auxiliaries. The ingenuity, self-reliance, adaptability, and technical knowledge as well as varied experience which the erecting engineer must possess make it possible for him to quickly become useful in ship work.	(1) Terms and conventions used in ship construction. (2) To construct and use a declivity board. (3) Familiarity with ship conditions.
Structural liner	Setting line for propeller shaft. (When not given by engineers or machinists.) Lining struts for propeller shaft and marking scarphs. Horning bulkheads. Laying off deck fitting such as rails, awning stanchions and fittings, hold and between decks stanchions, cleats, chocks, boat stowage, wood foundations, cargo battens, devil claws, chain stoppers, etc. (In most cases shipwrights install as well as lay off this work).	Running lines for shafting or shaft bearing. Lining shaft bearings. ..... Laying off for and installing machinery and equipment.	The processes and tools used by the shipwright are practically the same as those used by the erecting man and differ only in their application to ship machinery and conditions. The millwright or erecting man is accustomed to a level or nearly level floor and vertical walls. The shipwright is accustomed to a sloping deck and the curved sides of a ship.			

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Table IV

Comparison of Loftsman and Kindred Trades

Trade names.		Work done.		Comparisons.	
Ship trade.	**Structural trade.**	**Ship trade.**	**Structural trade.**	**Ship trade.**	**Structural trade.**
Loftsman (for linesman see below).	Template maker.....	Lays out and often makes wood and paper templates for frames, decks, foundations bulkheads, and other parts of the ship, working from drawing and layouts on the mold-loft floor, scrieve board or table.	Makes and lays out templates for plates and shapes, usually working from a drawing.	(1) Loftsman makes his template to lines drawn upon the floor by himself or a linesman. (2) Work may be very complicated. (3) Work may require a knowledge of development, especially in the shell work. (4) Loftsman may make few templates himself, leaving that to mold makers. (5) Full details are not always given on the drawing.	(1) Template maker makes his template from a drawing or from layout on the floor. (2) Work is usually straight, except in tanks, hoppers, curved trusses, etc. (3) Work usually does not require a knowledge of development. (4) Template maker lays out and makes templates as his special work. (5) Full details are usually given on the drawing.
	Structural marker or layer out.	As above.....	Lays out plates and shapes from template or direct from drawing.	(1) Loftsman lays out and often makes the template. (2) Loftsman lays out his lines full size upon the floor for the template.	(1) Structural marker lays out stock from the template or from the drawing. (2) Structural marker lays out no templates or template lines, but lays out stock.
Linesman.....	Structural draftsman or architectural draftsman.	Lays out body plan upon the floor. May draw sheer and half breadth plans. Develops all shells, stringers, plates, cantplating, and half width and height battens, stretch battens, etc. Lifts all bevels and makes ribband and harpin molds and all plate forms. (The work of the linesman is part of the loftsman's work, but is usually done by a special man or men.)	Draws as in any drafting room.	(1) Linesman works upon the floor in drawing plans and laying off and draws full size. (2) Linesman works with tools and materials and often is in closer contact with the actual structure than the draftsman.	(1) Draftsman works upon a drafting board and draws and lays off to scale. (2) Draftsman works with drawing tools only and usually is not in such close contact with actual materials and construction.

Trade names.		Work done.		Comparisons.	
Ship trade.	**Kindred trade.**	**Loftsman.**	**Kindred trade.**	**Loftsman.**	**Kindred trade.**
Loftsman.....	House carpenter..... Cabinetmaker.....	The work of the loftsman and special work of the linesman is as stated above.	Builds all forms of wooden structures and may do interior finishing.	(1) Loftsman lays out templates from drawings. (2) Loftsman makes wood templates for steelwork. (3) Loftsman deals with curved shapes and plates and develops surfaces. (4) Loftsman uses woodworking tools on light work (template making). (5) Loftsman works on molds or templates for parts of the ship and does not work on the structure as it develops. He must depend on his own power of visualization to see the relation of different parts.	(1) Carpenter builds his structure direct from drawings. (2) Carpenter builds his structure of wood. (3) Carpenter deals with straight work and no developed surfaces. (4) Carpenter uses woodworking tools on heavy and light work. (5) Carpenter works on the structure itself and does not have to depend on his power of visualization to see the relation of parts.
		Essentially the same comparisons to be made for the cabinetmaker and carpenter.			
	Sheet-metal worker...	As above.....	Lays out and develops sheet-metal patterns and works on and shapes sheet-metal plates up to 5 pounds weight per square foot. (Heavier sheets are handled by boiler makers.)	(1) No direct comparison to be made.	

Assets of structural workman.	What he must be taught.
(1) Knowledge of and skill in using woodworking tools..... (2) Knowledge of templates and template making..... (3) Knowledge of blue-print reading..... (4) Ability to lay out and measure accurately..... (5) Knowledge of structural plates and shapes. (The template maker is particularly adapted for mold making as template making and mold making are practically the same work.	(1) Terms and conventions used in ship construction. (2) Special points in ship blue-print reading. (3) Familiarity with and requirements of ship construction. (4) Special rules for water and oil tight work. (5) To lay out lines full size upon the floor accurately from various plans. (A template maker may have done similar work in a structural shop.) (6) For shell work and some other kinds of work the principles of development unless this work is all done by the linesman.
(1) Knowledge of templates and their use..... (2) Knowledge of blue-print reading..... (3) Knowledge of and skill in laying out stock from drawings and templates..... (4) Knowledge of plates and shapes and methods of fabrication..... (5) Ability to measure accurately.....	Same as the template maker with template making in addition, unless all templates are made by template makers.
(1) Knowledge of and skill in drawing..... (2) Ability to read blue prints quickly and accurately..... (3) Ability to measure accurately and lay off (to scale)..... (4) A knowledge of plates and shapes derived from drawing and design and possibly from shop experience. (5) Probably a knowledge of development. (The draftsman is best adapted to linesman's work rather than to general mold-loft work.)	(1) Terms and conventions used in ship construction. (2) Special points in ship blue-print reading. (3) To lay out full size upon the floor accurately from drawing. (4) Special rules and requirements in ship construction. (5) Special developments necessary in ship work. (6) Template making (if he is to do this work).
(1) Knowledge of and skill in using woodworking tools..... (2) Knowledge of blue-print reading..... (3) Ability to measure accurately and lay out. The carpenter's knowledge of and skill with woodworking tools is his chief asset and enables him to be used at once as a mold-maker. His ability to measure and lay out accurately enables him to grasp quickly other forms of moldloft work.	(1) Terms and conventions used in ship construction. (2) Template making. (3) Special points in ship blue-print reading. (4) To lay out templates. (5) Familiarity with and requirements of ship construction. (6) Special rules for water and oil tight work. (7) To lay out lines upon the floor. (8) Principles of development (unless this work is done by the linesman). (9) (The carpenter may lack ability to visualize clearly from a drawing.)
The assets of the cabinet maker and what he must be taught are the same as for the carpenter. He may be inclined to do work of too fine a character in template making.	
(1) Knowledge of and skill in using tools..... (2) Knowledge of blue-print reading and possibly some knowledge of templates..... (3) Ability to visualize..... (4) Ability to measure and lay out accurately..... (5) Knowledge of development.....	(1) Terms and conventions used in ship construction. (2) Special points in ship blue-print reading. (3) To lay out templates. (4) Familiarity and requirements of ship construction. (5) To lay out lines upon the floor. (6) Special rules for water and oil tight work. (7) Special developments necessary in ship work. (8) Template making.

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Table V

Analysis of the Shipwright's Trade

Classes of work done.	Men required for each class.	Individual duties.	Jobs done.	Analysis of operations.
Cradle and launching ways.	One leading man.....	Directs carpenters.....	Locate and run lines and grades; fit cribbing, blocking, wedges, and shoring.	1. Run line for spread of ways both sides of center line.
	15 to 40 carpenters.....	Perform all construction work preparatory to launching.		2. Run grade line, slope depending on weight and length of vessel.
	10 helpers.....	Handle material as needed and clean up and pile blocking and timbers.	Grease and clean ways, carry and pile lumber, remove chips.	3. Build cribbing to grade line. 4. Haul out ground ways. 5. Line ground ways to grade and give them transverse slope of ¼ inch per foot. 6. Fit bottom blocks neatly under ways. 7. Secure rib bands on edge of ways with lag screws. 8. Install spur shores, being careful not to force ways out of line. 9. Haul out sliding ways. 10. Scrape, plane, and clear all foreign matter from ground and sliding ways, especially grit. 11. Heat grease and put it on the ways. 12. After grease hardens, pull sliding way over onto greased ways. 13. Put strips of template stock over all openings to keep out dirt. 14. Bolt forward end of sliding ways to ground ways. 15. Put in blocking, fitting it to ship. 16. Install toggles and frapping where needed. 17. Put launching wedges in place.
Launching.....	Varies according to size of ship.			1. Grease up overboard ways ahead of tide.
	One foreman.....	Directs launching.		2. When all is ready, drive wedges until ship is firm in cradle.
	2 leading men.....	Directs carpenters.		
	About 80 carpenters.....	Launch the ship.....	Drive wedges, take out keel blocks, and release ship.	3. Split out keel blocks, which drops weight of ship to cradle.
	About 10 helpers.....	Assist carpenters.....	Grease the ways and assist carpenters.	4. When all is clear, men are ordered from under the ship prior to releasing. 5. Cut tie plank to release ship. 6. After ship is launched, helpers scrape off ways and remove timbers which are taken apart by the carpenters.
Fairing ship.....	10 carpenters.....	Do all fairing, shoring, and shifting of keel blocks for riveting.	Lay keel blocks.....	1. Establish grade line. 2. Lay keel blocks to grade line.
			Frame ship.....	1. Carry center line up from blocks vertically through the ship.
			Keep ship fair.	2. Establish base line. 3. Check all measurements on center line and base line.
			Horn bulkheads.....	1. Set bulkheads in ship. 2. Set bulkhead to proper declivity; that is, square with base line. 3. Set bulkhead square with ship by equal measurements on port and starboard side to fixed point on center line.
Building staging.....	Stage builders.....	Build staging.		
	2 helpers.....	Handle material.		
Miscellaneous:				
(a) Deck fittings...	Experienced carpenters. (Number depends entirely on size of ship.)	Do all lining, measuring, fitting, and placing, ready for riveting.	Place all deck fittings, rails, awning, stanchions, rail stanchions, pad eyes, lug pads, cleats, chocks, bitts, winches, capstan, windlass, stowage of spare anchors, chain plates, cargo davits, etc.	1. Get deck plan. 2. Measure for and line off for various fittings. 3. Locate fittings ready for drilling and riveting.
(b) Laying and calking wood decks.	Carpenters. (Number depends entirely on size of ship.)	Lay all wood decks.....	Lay decks.....	1. If mold loft has not laid off holes for fastening decking, carpenter runs check line parallel to center line of ship.
		May calk seams.....	Line off deck for drilling.	2. Lay off holes from center line with batten. 3. Houses ends of decking into margin at ship's side, where miter exceeds 45°. 4. Squares and planes finished deck to through water to sides, uses machine planer, and finishes by hand.
(c) Lining up.....	2 experienced carpenters..	Do all lining. (In many yards much of this work is done by outside machinists.)	Establish line for propeller shaft.	1. Determine position of propeller shaft line from base line and center line. 2. Stretch wire line in place from which measurements may be taken. 3. Lay off for boring castings.
			Line up stern and bow castings	1. Line up stern and bow castings in position from center line. 2. Mark scarphs for machining. 3. Line castings up on ship after they are machined.
	2 helpers.....	Shift line and assist as directed..	Do all other lining on ship.	
(d) Installing.....	Experienced carpenters...	Measure, line off, fit, and locate ready for fastening.	Locate all miscellaneous fittings, as, cargo-handling gear, cargo battens, pads for lead blocks, belaying pins, fair leads, boat-handling gear and stowage, anchor-handling gear, clench rings, wood grating, pads, chain stoppers, devil's claws, hawse pipe, windlass engine foundations, masts, and rigging.	1. Get drawings. 2. Measure and line off for various fittings. 3. Locate fittings.
	Helpers. (Number depends on size of ship.)	Duties as in lining off.		
(e) Spar making...	One spar maker.....	Performs entire operation alone.	Makes and installs square, octagonal, or round spars, masts, cargo booms, etc., and puts on fittings for them.	1. Hews square to dimensions from rough material. 2. Hews to octagonal shape. (⅛ squared.) 3. Hews to 16-sided shape. (1/16 squared.) 4. Tapers and planes round to shape with drawknife and plane. 5. Mounts with shroud and hound bands. 6. Fits with truck for signal halyards when required. 7. Steps mast in ship. 8. Plumbs transversely and puts to rake as desired. 9. Wedges masts as required.
(f) Calking.....	1 calker.....	Performs entire operation alone, except in deep seams.	Does all calking on water-tight wood decks.	1. Spreads cracks 1/16 inch with dumb iron and puts in cotton. 2. Puts in oakum with thread iron. 3. Finishes with making iron. 4. May if necessary in deep seams use horsing iron pounded in by helper with beetle.

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not absolutely necessary for all classes of work, that he be able to read blueprints and make rough sketches.

Men for the shipwright trade must be drawn from those requiring planning and assembling skill on both wood and metal structures (see Tables III and XVI). Fine skill in woodworking, such as that possessed by the cabinetmaker, joiner and inside finisher, is not required. Experience in any one of the following trades is an asset: Master carpenter or contractor, house carpenter, rough carpenter or handy man, bridge carpenter, house mover, dock and wharf builder, piledriver man, lumberjack, lumber yard and sawmill man, millwright, erecting engineer, liner on structural steel work, machine erector or road man, structural or bridge erector and elevator constructor.

Shipfitter

The work of the shipfitter is to lay out for fabrication and to assemble the various steel plates and shapes of which the ship is constructed (see Table VI). The work is similar to that of the structural marker, fitter and erector; in fact, it is a combination of all three. In the case of light work the shipfitter erects upon the ship; heavy work is erected by yard riggers and squared up by shipwrights. His work may be said to begin where that of the loftsman leaves off. In other words, he lays out, supervises the fabrication of, and assembles the parts for which the loftsman makes the templates. In addition to laying out from templates furnished by the mold loft, he also makes or "lifts" templates himself direct from the ship for pieces of special shape and sees that they are properly formed and fitted into place. Riveting in final position is done by riveters, not by shipfitters.

A shipfitter is pre-eminently a planner and assembler. He should be familiar with methods of fabricating plates and shapes, able to read blueprints and to lay out rapidly and accurately from templates or drawings. In addition, he should be able to "lift" his own templates from the ship when required; in fact, this is one of his most important duties. To be able to work on any part of the ship demands a special knowledge of ship construction and its special rules and requirements.

Men for shipfitting must be drawn from metal working trades requiring planning and assembling skill (see Table X). The trades most closely allied are the structural steel trades, in some of which work almost identical with some shipfitting processes is done. These trades are: Structural marker, structural fitter, structural erector, structural template maker, structural yard man and structural draftsman.

Trades less closely allied, but experience in which is an asset, are the following: Blacksmith, boilermaker, sheet metal worker, ornamental and architectural ironworker, jobbing machinist or auto repair man and house carpenter.

Anglesmith and Plate and Shape Furnaceman

In the process of ship construction some of the work on plates and shapes is done cold, such as drilling, countersinking, planing, shearing, beveling and rolling (see Table XVII). When a considerable amount of bending and shaping is required, the plates and shapes must be heated. The anglesmith and shape furnaceman heat and bend the shapes required for the framing of the ship, using as patterns the wood templates or molds furnished by the mold loft or lifted from the ship by ship fitters. The anglesmith bends and welds small lengths and light angular shapes in a shop equipped like a blacksmith shop with forges or small furnaces, anvils and ordinary blacksmith tools. The shape furnaceman or frame bender bends the large, heavy structural shapes used in the framing of the ship on a large iron floor known as the bending floor or bending blocks. The heating is done in an oil or gas furnace, 24 to 30 feet long and 8 or 9 feet wide. Templates for the frames are furnished by the mold loft. The plate furnaceman shapes the special plates for the ship in the same way, but uses somewhat different tools. In some yards a man is expected to do both plate and shape work; in others he specializes on one class of work only.

The qualifications for this work are those of a blacksmith trained on special work. The workman is primarily a fabricator, not a planner or assembler, though some planning is required in allowing proper amount of stock for bends and offsets. It is desirable, but not necessary, that he be able to read blueprints. Besides knowing proper temperatures for working he must understand in a practical way the behavior of shapes and plates when heated and cooled so as to make proper allowance for shrinkage and change of shape when cooling. This requires judgment which can be acquired only by experience and observation. On the light work of the anglesmith a man must work rapidly because the light weight angles cool much more rapidly than the solid bars to which a blacksmith is accustomed. Manual skill is required in bending, shaping and welding. An anglesmith works with one or two helpers on bending, shaping and welding. The plate and shape furnaceman works with a gang of four or more on bending and shaping, but not on welding.

Any trade in which a man bends and shapes or handles heated iron and steel is an asset in this work. These trades and occupations are: Blacksmith, horseshoer, wheelwright, blacksmith's helper, striker, back handler, ornamental and architectural ironworker and steel mill man.

Riggers and Sailmakers

The riggers in the rigging loft splice, serve and fit the wire and manila cable used on the ship and make and repair the slings used for hoisting in the yard (see Table XI). With the aid of helpers they install the standing and running rigging on the ship. Sailmakers cut, sew and fit sails and awnings for the ship. Measurements for both rigging and sails are taken by the leading man or foreman of the loft and the actual work is done by the workmen in the loft.

No special requirements are necessary for this work and the only occupation offering any assets for the rigging work is that of the sailor. Sailmakers may be recruited from sailors and tent and awning men.

Calkers

Calking in ship work is of two distinct kinds; calking of wood decks and the seams of vessels of wood construction and calking of seams between metal plates, of joints between plates and shapes and around rivets, pipe flanges, etc. (see Table IX). Calking of wood seams is done by spreading the seam, filling it with cotton and oakum, and pounding in with a wooden mallet and special calking tools. Wood calking is a distinctly ship trade. It is usually considered a part of the shipwright work, and there is no kindred outside trade, except the somewhat lighter calking done on launches, pleasure boats and other small craft.

Shipbuilding Trades of the Second Class

The ship trades in which there is a corresponding outside trade, but for which some special training is necessary, are the following: Plumber, pipefitter, coppersmith, sheet metal worker, ship joiner, ship electrician, blacksmith, outside machinist, chipper and calker and riveter.

Trades in the Pipe Shop

The trade of the marine plumber is very similar to that of the house plumber, especially as it relates to the piping and installation of sanitary fixtures and appliances (see Table XIV). The marine plumber does not install steam and hot water heating systems or gas piping for light and heat, two classes of work familiar to the house plumber. The marine plumber's work consists chiefly of running and fitting piping and fixtures for, and installing bath tubs, closets,

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Table VI

Analysis of Shipfitter's Trade

Group divisions.	Gang divisions.	Individual duties.	Jobs performed.	Job analysis.
Frame gang.....	2 first-class fitters.....	One fitter works on plates..... Other fitter works on shapes....	Lays out and assembles. ..... Frames: Bottom frames, side frames.	1. Gets molds from loft. 2. Orders stock into plate and angle shop. 3. After it is furnaced, marks stock, as indicated on molds, for punching, shearing, flanging, and location on ship.
	2 to 3 fitters' helpers.....	Helpers assist fitters as directed; hold chalk line; center punch plates through molds; assist in placing molds on plates for marking; mark rivet holes to be punched with marker; paint rivet holes as indicated by center punch marks; rough bolt the work as directed.	Reverse frames: Bottom frames, side frames. Brackets: At bilge, at decks.... Floors: Water-tight, nonwater-tight. Clips: Vertical keel, longitudinals, stringer, bracket.	4. After fabrication, assembles frames in sections, rough bolting up. 5. Assembles lower section, rough bolting frame and reverse frame angles to vertical keel and longitudinals to floor plate. 6. Assembles upper section, rough bolting brackets, angles, and clips to side frame. Midship frames are generally assembled in four sections, the forward and after frames in two sections, extreme ends in one section. Frames are installed by riggers and faired up by shipwrights.
Deck and inner bottom gang.	2 first-class fitters.....	1 fitter works on plates..... Other fitter works on shapes....	Lays out..... Deck plates, tie plates, clips, angles, beams.	1. Special shaped plates at end of closing strake are lifted from ship. (*a*) Fitter takes tools and battens to section to be fitted, adjoining work being already in place, he makes sure adjoining work is fair. (*b*) Clamps batten on the space where he is to make template. (*c*) Makes template to fit, using jackknife, hammer and tacks. (*d*) Nails other battens across for stiffeners. (*e*) Indicates on template all the necessary symbols, locates rivet holes, plate, frame, and hull numbers, also port or starboard. (*f*) Takes template to plate and angle shop and, if necessary, orders in his stock. (*g*) Clamps template on plate and transfers all the template marking to the plate by chalk line and center punch. (*h*) Removes template and with enamel or paint indicates all rivet holes, shearing, scarphing, and indication marks. 2. All other plates are developed in mold loft and fitter only performs operations (*g*) and (*h*). Deck plates and inner bottom plates are installed by riggers and faired up by shipwrights. Some decks are all plated, others partly plated and covered with wood.
	2 to 3 fitters' helpers.....	Helpers' duties, as above.....	Inner bottom: Plates, angles....	
Shell and vertical keel gang.	2 first-class fitters.....	On lifted plates, one fitter makes the templates, other fitter marks the plate. On plates developed in loft they both mark the plates.	Lays out shell plates by strakes, including special plates, garboard, sheer, oxter, tuck, boss, doubling, counter.	1. Special shaped plates and closing strakes are lifted from ship. 2. All other shell and vertical keel plates are developed in loft. See deck gang analysis. Shell plates are installed and rough bolted up by riggers.
	2 to 15 fitters' helpers.....	Helpers' duties, as above, except rough bolting, which is done by riggers; second-class fitters mark the regular plates.	Vertical keel, plates, butt-straps, and angles.	
Bulkhead and casings gang.	2 first-class fitters.	One fitter works on plates, other fitter works on shapes; part of the time they work together.	Lays out and assembles bulkhead and casing plates, brackets, butt-straps, plate collars, seam straps, angles, channels, bulb angles, staples, clips, bosom pieces or angle butt-straps.	1. Plate collars, bosom pieces, and some staples are lifted from ship. 2. All other bulkhead and casing plates and shapes are developed in loft. See deck gang analysis. Divisional bulkheads between decks are fitted by this gang. All heavy work is installed and rough bolted by riggers. All light work and fairingup is done by fitters.
	2 to 3 fitters' helpers.....	Helpers' duties, as above.....		
Stringer, deck girder, and longitudinal gang.	1 first-class fitter, 1 fitters' helper.	Work together.....	Lays out and assembles side stringers, upper, lower, panting; deck girders, inboard and outboard; longitudinals, first, second, third, etc.; breast hooks.	1. Bosom pieces for stringers, girders, and longitudinals are lifted from ship. 2. All other plates and shapes are developed in loft. See deck gang analysis. Stringers, breast hooks, and deck girders are assembled as complete as possible on ground. Longitudinals are assembled on ship. All heavy work is installed and rough bolted by riggers. All light work and fairing up is done by fitters.
Miscellaneous gangs....	Several gangs, each composed of one first or second class fitter; one helper for each fitter.	Each gang works separately.....	Lays out and assembles: Foundations, deck, auxiliary, engine and boiler, trunks, ventilation, coal, deckhouses, stanchions, manholes, fresh-water tanks, masts, king posts, hatches, oiltight, water-tight, nonwater-tight, coal, cargo; butt-straps, seamstraps, staples, bulwarks, shaft tunnels; doors, water-tight and nonwater-tight liners.	All templates furnished by loft, except bosom pieces. All templates furnished by loft. All templates furnished by loft, except frames fastened to casing and bulkheads. All templates are generally lifted from ship. See deck gang analysis. All heavy work is installed and rough bolted by riggers. All light work and fairing up is done by fitters.

Table VII

Analysis of Ship Joiners' Trade

Classes of work done.	Men required for each class.	Individual duties.	Jobs done.	Analysis of operations.
Outside work.....	1 joiner.....	Erects woodwork on the ship....	Lays joiner decks. (Decks up to 2 inches thick are called joiner decks. Thicker decks are ship carpenter decks.)	Works from blue print and install work according to layout exactly like any carpenter.
	1 helper for every 10 journeymen.	Carry material and assist as directed.	Puts on bulkhead wood sheathing; fits up cabins, staterooms, storerooms, workshops and cold-storage rooms; builds stairways, stepladders, panel work, and magazines.	
Inside work: (*a*) Joinery.....	1 joiner.....	Makes cabinet work for ship....	Makes all stationary furniture such as tables, seats, berths, sideboards, chiffoniers, cabinets, book racks, toilet cases, and mirrors.	Works from blue print and makes articles according to layout like any other joiner or cabinetmaker. Mortise and tenon work much more common than in outside work.
	1 helper for every 10 journeymen.	Carry material and assist as directed.		
(*b*) Machine operating.	3 to 6 millmen.....	Operate the following machines: Planer, band saw, tenoner, shaper, molder, mortiser, circular saw.	Form piece according to layout of joiner or turn out standard pieces.	

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Table VIII

Comparison of Pipe-Shop Trades and Corresponding Outside Trades

General qualifications for ship trades: A grammar-school education (a high-school education is desirable but not necessary to success, as many of the best men have only a grammar-school education); ability to read blue prints and to make accurate measurements; ability to make rough sketches; ability to see from the drawing the relation of various runs and bends of pipe so as to lay out work intelligently; a general knowledge of ship construction.

General qualifications for outside trades: Practically the same as for ship trades; drawings for outside work may not be so complicated, and hence are easier to read. A general knowledge of building construction instead of ship construction is necessary, especially for the pipe fitter and plumber.

Special qualifications for ship trades.			Special qualifications for outside trades.		
Marine plumber.	**Marine pipe fitter.**	**Marine coppersmith.**	House plumber.	Outside pipe fitter.	Outside coppersmith.
Skill in cutting, bending, and fitting lead, brass, and nickel-plated pipe, including particularly skill in making all forms of bends and connections in both large and small pipes, and in joint wiping; skill in making special fittings, such as traps and branches at all angles; skill in handling sheet lead for lining tanks, refrigerating rooms, and galley dressers and in working up and wiping seams; skill in making water-tight joints in decks and bulkheads; a knowledge of and skill in installing modern sanitary fixtures.	**Skill in cutting, threading, and bending pipes (and tubing of heavier gauges); skill in making flanged joints and in handling flange work, both screwed and expanded; skill in making tight screwed joints and in making all joints permanently tight, so that they will stand vibration; a knowledge of valves, fittings, and appliances used in steam, water, air, and refrigeration systems and their proper installation under various conditions.**	**Ability to lay out and develop sheet-metal patterns; skill in cutting, bending, and fitting copper pipe of all sizes, both hot and cold; skill in soldering, brazing, and flanging copper pipes of all sizes; skill in shaping large bends and special shapes from sheet copper; skill in bending large sizes of steel tubing of light gauge; a knowledge of the fittings and appliances used in steam, water, and air systems and their proper installation.**	Skill in cutting, fitting, and installing lead, cast-iron, steel, and nickel-plated pipe, chiefly in small sizes; some skill in joint wiping; a knowledge of modern sanitation and sanitary fixtures for bathrooms, water-closets, etc., used in dwelling houses, office buildings, stores, etc., and their proper installation; a knowledge of the State plumbing code if such is established, usually a knowledge of low-pressure steam, vapor, and hot-water heating systems and water-supply systems.	Skill in cutting and threading pipes of standard sizes and weights and in installing and making connections on such pipes with standard fittings, chiefly on straight work; ability to make tight joints, both screw and flange; a knowledge of fitting and appliances used on steam, hot-water, air, and refrigerating systems and their proper installation under various conditions; a knowledge of and skill in making tight joints for high pressures; usually a knowledge of low-pressure steam, hot-water, and vapor heating systems.	Skill in bending, working, and cutting copper pipe of all sizes, both hot and cold; skill in soldering, brazing, and flanging; skill in laying out and making small articles of copper, such as kettles, funnels, tanks, pans, etc. In sugar-factory, distillery, and brewery work, skill in forming and laying out larger shapes is required.

COMPARISON OF WORK DONE IN SHIP TRADE AND CORRESPONDING OUTSIDE TRADE.

Marine plumber.	House plumber.	Marine pipe fitter.	Outside pipe fitter.	Marine coppersmith.	Outside coppersmith.
1. Must use large sizes of lead pipe, such as 4".	1. Usually is accustomed to use smaller sizes of lead pipe.	1. Has special sizes, standards, and kinds of pipe specified by the Government.	1. Uses standard pipes and sizes.	1. Handles large sizes of pipe.	1. Usually handles smaller sizes of pipe.
2. Must be very accurate in his work.	2. No need of great accuracy.	2. Must do a great deal of pipe bending of all kinds and shapes, especially large sizes (85 per cent of work is bent).	2. Is accustomed to very little pipe bending; makes bends with fittings; does straight work.	2. Does a great deal of special work.	2. Makes standardized forms and shapes.
3. Must do a large amount of joint wiping, especially on large sizes of pipe.	3. May know little of joint wiping of any kind.	3. Lifts templates.	3. Rarely uses templates.	3. Makes large pieces which must stand rigid inspection.	3. Makes smaller pieces which may not have to stand rigid inspection.
4. Makes water-tight joints in decks and bulkheads.	4. Makes few water-tight joints in floors or partitions.	4. Must be very accurate, because piece must fit and not be strained into place.	4. Does not need to exercise great accuracy; accustomed to considerable leeway.		
5. Must do work suited to a particular job.	5. Accustomed to standardized work.	5. Cannot spoil tubing without inconvenience and delay, as it is difficult to obtain.	5. May spoil a piece of pipe and get another easily.		
6. Does no cast-iron soil-pipe work.	6. Does considerable cast-iron soil-pipe work.	6. 90 per cent of work is flanged even on small sizes.	6. Flange work is not so common.		
7. Makes traps and special fittings.	7. Buys traps and special fittings.	7. Must do a large amount of expanded work and peen joints.	7. May not be accustomed to expanded work and peened joints.		
8. Lines tanks and refrigerating rooms with sheet lead and works and wipes seams.	8. May have little experience in handling sheet lead and wiping seams.	8. Must work where clearances are small and space is cramped.	8. Accustomed to work where clearances are large and space to work is not so cramped.		
9. Must do work which is up to fixed standards.	9. May be accustomed to doing work in the cheapest way.				

Table IX

Analysis of Trade of Chippers and Calkers

Classes of work done.	Men required for each class.	Individual duties.	Jobs done.	Analysis of operations.
Machine chipping.....	Chipper works alone.....	Cuts, chips, splits, and files metal	Cuts and trims ends of bars, chips castings, such as stem and stern post; cuts scarphs; flushes rivets.	1. Chooses tool and puts it in air hammer. 2. Takes one or more rough cuts. 3. Takes finishing cuts to finish piece to desired shape and size.
			Cuts out bad rivets.....	1. Cuts through center of rivet head with cape chisel. 2. Takes cut on each side with cape chisel. 3. Finishes with flat chisel.
			Chips off flat surface.....	1. Takes cape chisel and cuts parallel grooves across piece to the desired depth. 2. Takes flat chisel and removes metal between grooves. 3. Smooths and finishes the surface.
Hand chipping.....	As above.....	As above.....	As above, except that handwork is done where air tools can not be used conveniently and in cleaning up odd jobs.	1. Same as above, except that hand hammer instead of air hammer is used.
Machine calking.....	Calker works alone.....	Calks angles, seams, and rivets, on metal work; does no woodwork.	Calks rivets.....	1. Chips head off rivet if necessary. 2. Uses rough calking tool around rivet when necessary. 3. Finishes with rivet set.
			Calks lap seams.....	1. Fairs edges of plates by chipping, except on planed edges. 2. Splits edge of plate with splitting tool. 3. Jams or staves lower edge of split down on lower plate with calking tool, making it smooth and watertight.
			Calks butt seams.....	1. Fairs up edges of plates. 2. Splits edges of plate against each other with splitting tool. 3. Calks edges down with rough calking tool.
Hand calking.....	As above.....	As above.....	As above, except that handwork is done where air tools can not be used conveniently and in cleaning up odd jobs.	NOTE.—Care must be taken not to calk a seam too hard or it will spread the edges of plates apart, and on light plates it will make a bump or "break it in" on the other side of the plate.

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Table X

Comparison of Shipfitter and Kindred Trades

Trade names (kindred trade.)	Work done.		Comparisons.	
	Ship fitter.	Kindred trade.	Ship fitter.	Kindred trade.
Structural marker or layer out.	Lays out steel plates and shapes from wood and paper templates or from drawings; lifts and lays off templates; fits, assembles, and places parts on ship.	Lays out steel plates and shapes from templates or drawings; may do some assembling.	(1) Ship fitter deals with bent work and curved plates as well as straight work. (2) Ship fitter lifts and lays off templates. (3) Ship fitter assembles and places parts.	(1) Structural marker deals chiefly with straight work, except tanks, hoppers, bent shapes, etc. (2) Structural marker may lay off but does not lift templates. (3) Structural marker does not usually assemble and place parts.
Structural fitter	As above	Assembles, fits, and bolts parts in the shop, such as trusses, girders, columns, etc.	(1) Ship fitter lays out work. (2) Ship fitter lifts and lays off templates. (3) Ship fitter places and fits parts in the yard, shop, or on the ship.	(1) Structural fitter does not usually lay out work. (2) Structural fitter does not lift and lay off templates. (3) Structural fitter fits and places parts in the shop or yard but not on the structure itself.
Template maker	As above	Makes templates for plate and shapes from a drawing.	(1) Ship fitter lifts and lays off templates. (2) Ship fitter lays out work from templates. (3) Ship fitter fits, assembles, and places parts on ship.	(1) Template maker makes templates from drawing and lays them off. (2) Template maker lays out templates. (3) Template maker does not fit, assemble, and place parts.
Structural draftsman	As above	Draws, traces, and checks structural drawings.	The draftsman lacks actual experience in handling, fitting, shaping, and laying out materials unless he has had shop experience. No direct comparison of work can be made.	
Structural erector	As above	Erects steel work in place for riveting and may do riveting.	The erector has very little work in common with the ship fitter, as he is concerned chiefly with hoisting, placing, and riveting processes, which are outside of, or a very small part of, a ship fitter's work.	
Boiler makers, sheet-metal workers, machinists, blacksmiths, carpenters.	NOTE.—House carpenters may be trained as ship fitters, their assets being (usually) a knowledge of blue-print reading and skill with woodworking tools. Blacksmiths and machinists are more easily adapted, as they are accustomed to metal working. Sheet-metal workers and boiler makers are accustomed to handling plates and have, in addition, a knowledge of developments, hence are more easily trained than any of the others.			

Assets of man in kindred trade.	What he must be taught.
(1) Knowledge of templates and drawings and skill in laying out. (2) Knowledge of plates and shapes and how to handle them. (3) Knowledge of blue-print reading. (The structural marker or layer out is particularly adapted to laying out in the shop or yard.	(1) Terms and conventions used in ship construction. (2) Special points in reading ship blue prints. (3) Familiarity with and requirements of ship construction. (4) Special points in handling bent and curved work. (5) Special rules for water and oil tight work. (6) To lift and lay off templates. (7) To fit, assemble, and place parts on ship.
(1) Knowledge of plates and shapes and how to handle them. (2) Knowledge of and skill in fitting structural work. (3) Probably some knowledge of blue-print reading. (The structural fitter is best adapted for assembling in the steel mill or in the yard.)	(1) Terms and conventions used in ship construction. (2) Special points in reading ship blue prints. (3) Familiarity with and requirements of ship construction. (4) To lay out work from templates. (5) Special rules for water and oil tight work. (6) Special points in handling bent and curved work. (7) To lift and lay off templates. (8) To fit, assemble, and place parts on ship.
(1) Knowledge of blue-print reading. (2) Knowledge of and skill in template making and in marking and laying off. (3) Knowledge of plates and shapes and how to handle them. (The best place to use the template maker is in the mold loft as a mold maker, as the work of these two trades is practically the same.)	All of the above. He would no doubt learn very quickly to lay out plates and shapes, but would need to be taught particularly fitting and assembling.
(1) Knowledge of blue-print reading. (2) Knowledge of plates and shapes. (3) If he has had shop experience he is probably familiar with laying out and fitting and with handling plates and shapes.	The structural draftsman with shop experience will need to be taught the same points as the marker or fitter. If he has not had shop experience he will need to become familiar with the handling of materials and with construction methods.
(1) Knowledge of plates and shapes and how to handle them. (2) Possibly a knowledge of blue-print reading. (3) Possibly knowledge of and skill in riveting. (4) Resourcefulness and energy. (The erector is particularly adapted to rigging and assembling work in the yard or on the ship. If he has done riveting he may be used as a riveter. He would probably be most useful as an assembler in a fabricating yard. His resourcefulness and energy make him valuable in getting work out rapidly.	The structural erector will need to be taught the same points as the marker or fitter and will need instruction in laying out and in blue-print reading particularly.

Table XI

Analysis of Riggers' and Sailmakers' Trades

Classes of work done.	Men required for each class.	Individual duties.	Jobs done.	Analysis of operations.
Inside work, rigging	1 journeyman rigger (usually works alone).	Fits all standing and running rigging and makes slings for crane work. No rope making is done.	Splices and fits steel and manila cables and ropes for all purposes. With helpers, installs rigging on ship.	1. Leading man furnishes necessary measurements. 2. Riggers cut and fit ropes and cables according to the measurements.
Sailmaking	1 sailmaker (usually works alone).	Makes sails and canvas coverings for protection of material in the yard.	Cutting out, sewing, and fitting of sails.	1. Leading man furnishes all measurements. 2. Sailmakers cut, sew, and fit.
Outside work— (a) Hoisting and rigging.	1 rigger, usually called "yard rigger." 1 to 10 helpers	Handles and places machinery ready for erection. Carry ropes and chains and hitch as directed by the rigger.	Places pumps, boilers, engines, air compressors, coolers, heaters, etc.	1. Sizes up job and determines method of hitching, size and kind of slings to be used, etc. 2. Makes hitch and hoists slowly, making sure that hitch is secure and the load balanced. 3. Continues hoisting to necessary height and places in proper location.
	1 crane operator, 4 riggers and helpers (on each crane).	Handle cranes.	Hoist, shift, and place machinery and material beneath the cranes.	As above.
(b) Pipe covering (in most yards this work comes under the pipe fitters).	1 pipe coverer 1 helper 1 canvas man	Puts on magnesia, asbestos, or hair felt pipe covering. Carries material, mixes cement, and assists as directed. Sews canvas.	Covers steam pipes, hot and cold water pipes, boilers, tanks, feed-water heaters, evaporators, etc.	1. Measures up pipe to be covered. 2. Gets proper size of covering. 3. Covers straight pipes. 4. Fills in around elbows, valves, and other fittings with cement as needed. (In covering irregular shapes cement is used.) 5. Covers pipe covering with canvas and sews it on.

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Table XII

Analysis of Riveters' Trade

Classes of work done.	Men required in each gang.	Individual duties.	Jobs done.	Analysis of operations.
Machine riveting: (a) Pneumatic hammer riveting.	1 riveter	Drives the rivets	Does all plate and shape riveting. Some parts are riveted before assembling and the balance is done on the ship.	1. Puts die on rivet and drives with air hammer using proper die, for snap riveting length of rivet must suit die. 2. If rivet is flush, chips off extra metal. (See illustration.) 3. Drives second rivet while first is cooling and shrinking. 4. Drives first rivet again to make it smooth and tight using a flush die to calk the rivet all around. A loose rivet has to be cut out and reriveted. 5. Loosens bolt for next rivet when necessary.
	1 holder-on	Holds rivet in place while it is being driven.		1. Takes rivet from passer and puts it in rivet hole if passer does not do so. 2. Holds rivet firmly with air holding-on hammer or with jam hammer for very heavy work. 3. May take rivet direct from heater boy if fire is close by.
	1 passer	Takes rivet from heater boy and places it in rivet hole.		1. Receives rivet from heater boy with passing tongs. 2. Passes or throws rivet to holder-on or may place rivet in rivet hole.
	1 heater boy	Keeps fire and heats rivets		1. Puts rivets in fire 5 or 6 at a time. 2. Watches to prevent overheating. 3. Removes rivets one at a time with heating tongs when properly heated and hands them to passer.
(b) Bull riveting	1 riveter	Operates riveter	Usually does snap riveting on frames and nonwater-tight work. May sometimes do flush riveting on bulkheads and water-tight doors where work is not more than 3 feet from the edge.	1. Brings die over upper end of rivet. 2. Pulls lever to operate riveter. 3. Releases riveter to free die for next rivet. 4. Loosens bolts when necessary.
	1 holder-on	Takes rivet from heater boy and puts it in hole.		1. Puts rivet in hole. 2. Places die over lower end of rivet.
	1 heater boy	Keeps fire and heats rivets		
	1 to 4 helpers	Handle frames or any part being riveted.		
Hand riveting	1 right-hand riveter	Drives rivets on right-hand side	Does all plate and shape riveting where it is not convenient to get an air line, also cleans up odd jobs.	1. Takes proper shaped hammer for work. 2. Hammers rivet into shape. 3. Calks rivet with tomahawk after shrinking and cooling
	1 left-hand riveter	Same as right-hand riveter on opposite side working with him.		1. Same as right-hand riveter.
	1 holder-on	Same as in machine riveting		1. Same as in machine riveting except that he uses a hand holding-on hammer or dolly bar.
	1 passer, 1 heater	....do		1. Same as machine riveting.

Table XIII

Analysis of Sheet-Metal Workers' Trade

Classes of work done.	Men required for each class.	Individual duties.	Jobs done.	Analysis of operations.
Lockers	1 first-class man 2 second-class men 3 apprentices	Lays out and cuts Form and assemble work. Assist journeymen.	Makes all lockers, both wire and sheet steel.	1. Cut netting to template. 2. Cut and bend angles to template. 3. Assemble. 4. Rivet over and finish. Works on metal up to 5 pounds per square foot.
Auxiliary condensers and feed and filter tanks.	1 leading man 1 first-class boiler maker. 2 second-class boiler makers. 2 riveters. 2 holders-on. 2 passers 2 heaters. 1 machinist 1 welder (acetylene) 1 driller 2 helpers	Lays out work Form and assemble work. Duties as in any riveting work. Expands tubes. Welds seam. Drills for rivets. Assist as directed.	Make all feed and filter tanks and auxiliary condensers.	1. Lay out. 2. Cut. 3. Assemble and weld seam. 4. Drill and rivet flanges. 5. Put on head and insert and expand tubes. 6. Test and inspect.
Expansion joint between uptake and smokestack.	1 first-class man 1 helper	Makes job complete Assists as directed.	Makes and installs expansion joint.	1. Lay out. 2. Cut and assemble. 3. Rivet.
Jackets for dry steam pipes.	1 first-class man 1 helper 1 acetylene welder	Lay out and form Assists as directed. Welds seam.	Makes jacket complete, except slotting.	1. Lay out. 2. Cut and form. 3. Weld. 4. (Jacket is slotted in the machine shop.)
Tanks	1 leading man 1 first-class man 3 third-class men. 1 calker 1 riveter. 1 holder-on 1 passer. 1 heater. 5 helpers	Lays out work Cut, form, and assemble. Calks seams and flanges. Duties as in any riveting work. Assist as directed.	Make fresh-water tanks, fuel and lubricating oil tanks of different sizes (500 gallons or less); also lifeboat tanks.	1. Lay out. 2. Cut to lay out. 3. Assemble. 4. Rivets seams and flanges. 5. Calk and test.
Smokestacks	1 leading man 2 first-class men 3 third-class men. 1 riveter. 1 holder-on 1 passer and heater. 7 helpers	Lays out work Cut, form, and assemble. Duties as in any riveting work. Assist as directed.	Make and install all smokestacks from uptake up, including expansion joint.	1. Lay out. 2. Cut to lay out. 3. Form and assemble. 4. Rivet. 5. Install.
Ventilation	1 layer out 2 first-class men 3 third-class men. 3 apprentices 2 helpers. 1 spot welder (when necessary).	Lays out work Cut, assemble, and rivet or double seam. Aid in assembling and installing.	Make and install all ventilation systems, except blowers.	1. Lay out. 2. Cut to lay out. 3. Form and assemble. 4. Rivet, double seam, or spot weld according to weight of material. 5. Install.
Cowl making	1 cowl maker 2 helpers. 1 spot welder (when necessary).	Lays out and makes cowls	Makes and places all cowls for ventilating systems.	1. Lays out. 2. Forms and assembles. 3. Rivets or spot welds (heavy cowls riveted, light ones spot welded). NOTE.—Sheet-metal men do riveting up to ½-inch size. Boiler makers do heavier riveting. Spot welders and acetylene burners are not sheet-metal men.

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Table XIV

Analysis of Trades in the Pipe Shop

Trade	Men in gangs.	Individual duties.	Jobs done.	Analysis of operations.
Pipe fitter	1 fitter	Fit and install all iron, steel, brass, and galvanized pipe, shelby and seamless steel tubing for water, steam, and air systems.	Runs, fits, and installs piping for engines, condensers, pumps, water supply, distillers, evaporators, oil-burning outfits, refrigerating systems, steam heat, and cargo, and deck machinery piping.	
	1 helper	Carries pipe, helps bend pipe, fills pipe with sand, cleans pipe, handles oil torch, and assists as directed by fitter.		
			Lays out holes for piping and fixtures from drawings.	1. Lays out holes. 2. Holes are drilled (and tapped when necessary) by drillers.
		Helpers duties as above	Bends pipe either hot or cold, depending on size of pipe, sharpness of bend, weight of pipe, etc.	1. Lifts wire template from ship for shape and length of pipe. (May have wood template built by carpenter showing angle of flanges and alignment of bolt holes at each end.) 2. Fills pipe with sand if necessary. 3. Places on bending blocks and heats with oil torch (if pipe is to be bent hot). Pipe may be heated in a forge. 4. Bends pipe to template either by hand or with hydraulic bender, cooling and heating different sections as necessary. 5. Tests pipe for shape and length. 6. Cuts pipe to fit template. 7. Puts on flanges, aligning bolt holes to suit template when necessary. 8. Expands pipe into flanges with straight or grooved expander, unless threaded flange is used. 9. Penes inside of drawing unless threaded flange is used. (Machinist faces off the flange after penning.) NOTE.—Small sizes of brass pipe are usually annealed and bent cold. Sizes of 1 inch and upward are bent hot.
		As above	Flanges pipe— (a) Expanded joints (b) Threaded flanges	Operations as above. 1. Threads pipe. 2. Makes up pipe and flange.
		Do	Makes pipe connections and installs fittings— (a) Threaded	1. Paints joint with red lead, litharge, or pipe cement according to circumstances. 2. Makes up joint with stillson or chain tongs.
			(b) Flanged	1. Puts in copper gasket, rubber gasket, fiber gasket, or makes metal-to-metal joint between the flanges. 2. Bolts flanges together. NOTE.—Outside machinist makes up all joints in direct contact with machinery, including joints in the following systems in the machinery spaces: Steam and exhaust, suction, and discharge piping.
Plumber	1 plumber	Fit and install all lead, brass, nickel plated, and some galvanized pipe for sanitary systems and appliances.	Run and fit piping and fixtures for and install bathtubs, closets, urinals, showers, lavatories, sinks, and lead lining of tanks, pipes, and refrigerating rooms; cast lead base for closets from wood pattern.	
	1 helper	Handles heavy tools, helps to bend pipe, fills pipe with sand, and assists as directed by the plumber.		
			Lays out holes for piping and fixtures on decks and bulkheads from drawings.	1. Lays out holes. 2. Holes are drilled (and tapped when necessary) by drillers.
		Helpers duties as above	Bends lead pipe	1. Makes template. 2. Fills pipe with sand if necessary. 3. Heats slightly when required. 4. Bends. 5. Bumps out with knocking-out tool.
		As above	Wipes joints for branches, fixtures, and connections.	1. Scrapes surface of pipe clean and prepares same for wiping. 2. Pours on solder. 3. Wipes to shape.
		Do	Works sheet lead and wipes seams for lining tanks, galley dressers, and refrigerating rooms.	1. Puts in lining. 2. Works to surface. 3. Works up corners. 4. Wipes seams.
		Do	Lines pipes with lead tubing	1. Greases inside of pipe to be lined and the lead lining. 2. Puts lining in pipe. 3. Penes over the end of the lining against the pipe flange. 4. Inserts torpedo or steel plug of the size of finished lining. 5. Puts on flange and forces torpedo through the pipe by hydraulic pressure.
		Do	Makes oil-tight and water-tight joints in bulkheads and decks, using canvas, red lead, rubber, etc.	
Coppersmith	1 coppersmith	Bends, fits, and installs all copper pipe and fittings. (On destroyer work bends steel tubing, especially the larger sizes of light gauge.)	(a) On merchant vessels, makes main exhaust connection for receivor and suction and discharge connections for condenser. (b) On destroyers, installs 60 per cent of all piping ready for jointing.	
	1 helper	Helper's duties same as for plumbers and pipe fitters.	Lays out holes in bulkheads and decks for pipes and fixtures from drawings.	1. Lays out holes. 2. Holes are drilled (and tapped when necessary) by drillers.
		As above	Bends pipe	1. Makes wire template and may have wood template for flanges built by carpenter. 2. Anneals pipe if it is to be bent cold. 3. Fills with sand or rosin. 4. Bends by hand or with hydraulic bender to template. 5. Cleans pipe.
		Do	Makes large bends from sheet copper	1. Bends and hammers sheet into shape. 2. Brazes seams and makes them flush. 3. Finishes seams with portable emery wheel.
		Do	Brazes pipe, fittings, and flanges.	
		Do	Shapes large pieces such as condenser head, main exhaust to receiver, suction and discharge pipes.	1. Lays out pattern from detail pipe drawings. 2. Makes template or uses standard template for groups of three or more. 3. Hammers sheet into shape with mallet and forming tools. 4. Brazes seams and rivets on flanges.
		Do	Rivets angles or flanges on pipes or condenser heads as required (riveting done cold).	
		Do	Tins pieces when required.	
		Do	Solders.	

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urinals, showers, lavatories and sinks. He also uses sheet lead in lining tanks, refrigerating rooms and galley dressers, lines pipes with lead tubing, and casts the lead base for closets from a wood pattern rammed in sand. The tools, materials and methods used and the operations performed by the marine and house plumbers are the same. The differences arise from the conditions to be met.

The work of the marine pipefitter and that of the outside pipefitter are even more closely akin than are the work of the house and marine plumber (see Table XIV). Their field is the installation of iron, steel, brass and galvanized pipe, steel tubing and fittings for high and low pressure steam, hot and cold water supply systems, air, oil and refrigerating systems. In marine work the outside machinists make up a number of joints which in outside work would be handled by pipefitters, notably those in the machinery spaces. Tools, materials and operations are the same in both cases.

The work of the marine coppersmith is that of fitting and installing copper pipe and fittings (see Table XIV). His work differs from that of the plumber and pipefitter in that he must make large pipes and bends and form large special shaped pieces such as condenser heads, exhaust connections of sheet copper and must do brazing and flanging. The outside coppersmith, unless employed on brewery or sugar factory equipment, is usually accustomed to much smaller, lighter work than the marine coppersmith.

These three pipe-shop trades are closely related to each other as well as to the corresponding outside trades, but all three differ from the corresponding trades in three special particulars (see Table VIII): 1—Water-tight joints must be made in many cases around pipes where they pass through bulkheads; 2—pipe bending is much more common; 3—flange joints are much more common and must be sufficiently well made to stand the vibration and strain of the ship. These differences are simply due to ship conditions and do not imply any fundamental difference in trade knowledge or skill. Any experienced journeyman plumber, pipefitter, or coppersmith can become competent on ship work in a short time and with very little special training. In recruiting men for ship work these three trades should be drawn upon, as there are no other kindred trades and the common fund of trade knowledge and skill is very large.

Sheet Metal Worker

The sheet metal worker on a ship works and fits sheet metal up to five pounds weight per square foot (see Table XIII). The metal may be sheet iron or steel, galvanized or plain, sheet brass or copper. Two main differences exist between ship work and that outside:

1—In ship work water and oil-tight work is very important. In many lines outside this is of no importance whatever. 2—The variety of work called for in shipbuilding is much greater than that represented by any one line of outside work. Ship work comprises smokestack work, including expansion joints, cowl making, ventilation work, tank work and sheet steel and wire mesh locker work. Men who are specialists in any one of these lines can be used in ship work on the same special line. In practically every case the new man must receive special instruction and training on the water-tight work.

Desirable craftsmen for ship work on sheet metal are the heating and ventilation man, tank man, sheet steel and wire mesh locker man, blowpipe man (man who installs blower systems in woodworking plants), cornice man (desirable because of his varied experience).

Tinsmiths and furnace men are sometimes not so desirable because they are accustomed to small light work. In case they have had experience on heavier and more complicated work they can be more quickly trained to ship work.

Ship Joiner

The ship joiner is the cabinetmaker and inside finisher (see Table VII). Painting, oiling, varnishing, and general wood finishing are done by the painter, not the cabinetmaker. Any good cabinetmaker is capable of doing corresponding work on the ship or in the joiner shop. Carpenters with experience on inside finish are useful on the ship and in the cabinet shop. In connection with the ship work they must become accustomed to the slant or bevel cuts and to metal fittings.

Desirable craftsmen for ship joinery are the cabinetmaker or joiner, furniture maker and carpenter with experience on inside finish.

Machine operators for the cabinet shop, such as molder, sticker, planer, and shaper hands, may be obtained from the corresponding occupations in planing mills, sash and door, and furniture manufacturing plants.

Ship Electrician

The work of the ship electrician corresponds closely to that of the outside electrician in its various phases. In the shipyard there are two general classes of work, outside and inside. The former is that done in the yard and shops and comprises the installation and maintenance of equipment used therein. This work does not differ from that of any electrician employed in factory or yard work, and includes outside linework, installation and repair of motors and generators and light and power circuits.

Inside work, or work on the ship, comprises the installation and maintenance of all electrical equipment on the ship with the exception, in some cases, of the storage batteries. Most of the work is direct current with no high voltage. No cleat or open work is done and little or no knob and tube work. Most of it is conduit work.

The following points require special attention in the case of the new man, taking for granted that he possesses the knowledge and skill of a competent inside wireman: Methods of making steam-tight and water-tight joints around wire, the use of armored cable, specifications such as Lloyd's code and special government specifications differing from the underwriters' code, care in installing conduit work because it is not concealed, complicated connections for intercommunicating systems, speaking tube work and engine telegraphs.

Desirable craftsmen for ship electricians are the inside wireman with experience on conduit work, telephone switchboard man on intercommunicating systems, telephone installer, trouble shooter and wire chief, repair man on motors and generators, armature winder and switchboard installer. Meter man and experts on auto starting systems do not have sufficient experience on installation to make them immediately useful.

Blacksmith

In ship work the work of the anglesmith, frame bender and furnace man, though similar to that of the blacksmith, is distinct and has already been described. The blacksmith shop proper contains the following classes of men: Hammermen or heavy forgers, machine blacksmiths, shipsmiths, dropforgers, tooldressers and helpers and strikers.

Hammermen or heavy forgers are employed in corresponding outside trades. They can readily do the heavy-hammer forging on ship work save in very special cases, such as sternposts, rudders and rudder posts. The shipsmith forges the chains, fittings, bands and special forgings for the rigging. For this work the railroad blacksmith or machine blacksmith is particularly adapted. The railroad blacksmith, however, is usually not accustomed to close work, but is more rapid and resourceful

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Table XV

Comparison of Structural and Ship Riveters

Trade names.		Operations.		Comparisons	
SHIP RIVETING GANG.	STRUCTURAL RIVETING GANG.	SHIP GANG.	STRUCTURAL GANG.	SHIP GANG.	STRUCTURAL GANG.
Riveter	Riveter	I. Machine riveting: (a) Long stroke air hammer riveting— (1) Puts die on rivet and drives using proper die. (2) If rivet is flush, chips off extra metal. (3) Drives second rivet while first is cooling and shrinking. (4) Drives first rivet again making it smooth and tight.	I. Machine riveting: (a) Long stroke air hammer riveting— (1) Puts die (usually snap die) on rivet and drives. (2) Drives rivet tight and clean as possible in one operation. (3) Loosens bolt for next rivet. (5) Loosens bolt for next rivet. Drives rivets on both sides of bolt when possible.) (If snap rivet is used, the rivet is finished in one operation.)	(1) Ship work is largely water-tight and oil tight and requires great care. (2 Drift pin must be carefully used and partially blind holes reamed out. (3) Ship riveter may go over rivets a second time to finish and make tight. (4) Ship riveter nearly always uses flush die. (5) Length of rivet must suit die. (6) Short rivet can not be used on flush work because it will not fill the hole.	(1 Structural work (except tank and similar work) is not water tight and does not require so much care. (2) Drift may be used in many cases without harm instead of reaming the holes. (3) Structural riveter finishes rivet in one operation. (4) Structural riveter does not often use a flush die. (5) Length of rivet not so important except on inspected work. (6) Short rivet may possibly be used because it is not so necessary to fill the hole completely.
Holder-on	Bucker-up	Places dolly bar, air holding on hammer, jam hammer, or long stroke air hammer on rivet and holds on or drives.	Same as in ship gang except that dolly bar is usually used. Air dolly bar may be used on bridge work.	Practically no difference to be noted in ship and structural gang.	
Passer	Passer or sticker	Passes rivet to holder on or puts it in rivet hole.	Same as in ship gang, but hold on or drive.	Practically no difference to be noted. A structural passer may have to catch rivets in keg or pail. A ship riveter does not have to catch rivet in this way.	
Heater	Heater	Puts rivets in fire and heats them. May throw rivets if necessary.	Same as in ship gang, but throwing rivets is more often done and much more important.	(1) Usually has advantage of compressed air for fire. (2) Usually does not throw rivets any distance. (May throw rivets in tank work.)	(1) May not have compressed air for fire and may have to use a hand forge. (2) May have to throw rivet some distance.
Riveter	Riveter	(b) Bull riveting (riveting with air or hydraulic machine)— (1) Puts die over one end of rivet.	Same as in ship gang (2) Pulls lever to operate riveter. (3) Releases riveter to free die for next rivet. (4) Loosens bolts as required.	Practically no difference between ship work and structural work. Bolting up on ship work must be carefully done.	
Holder on (1 holder on is usually required on a vertical machine and 2 on a horizontal machine).	Holder-on or helper	(1) Steadies work or machine or shifts work or machine as required. (2) May loosen bolts.	Same as in ship gang	No difference between ship work and structural work.	
Passer	Passer or sticker	(1) Knocks off scale. (2) Puts rivet in hole. (3) Steadies work or machine	Same as in ship gang	No difference between ship work and structural work.	
Right-hand riveter Left-hand riveter Some riveters both in structural and ship work can drive either right or left handed. In this case a "single handed" gang is used.	Right-hand riveter Left-hand riveter.	II. Hand riveting Same operations as in riveting with air hammers. Tomahawk may be used to finish rivet. Head is formed by hammer or rivet set and die.	Same as in riveting with air hammer.	Same comparisons as in air-hammer riveting.	
Holder on Passer Heater	Holder on Passer. Heater.	Same as in air hammer riveting.	Same as in air hammer riveting.	Same as in air-hammer riveting.	

Assets of structural workman.	What structural workman must be taught.
(1) Knowledge of rivets and riveting and skill with riveting tools (2) Knowledge of and skill in erecting and assembling. (3) No fear of location.	(1) Terms, conventions, and special tools used in ship construction. (2) To realize necessity of care in water and oil tight work; must sacrifice speed when necessary. (3) Not to use a drift pin except with great care and judgment. (4) Not to rivet partially blind holes but to have them reamed out. (5) To remove bad and tighten loose rivets. (6) To go over flush rivets a second time on water-tight work. (7) To make all rivets fill the hole. (8) To tell when a job is properly bolted up. (A bridge riveter has been accustomed to requiring careful bolting.)
(1) Knowledge of and skill in performing duties of holder on or bucker-up	(1) To use air holding on hammer, jam hammer, or other special tools and dies used in ship work. (2) Familiarity with ship conditions.
(1) Knowledge of duties and necessary skill for passer (2) Probably a knowledge of heating, driving, and holding on.	(1) Familiarity with ship conditions. (2) To spot burned rivets and not put them in the hole. (This is to save time.)
(1) Knowledge of duties of heater and skill in heating rivets (2) Skill in throwing rivets.	(1) Familiarity with ship conditions.
(1) Knowledge of and skill in operating horizontal and vertical air and hydraulic bull riveters. (2) Knowledge of rivets and riveting processes.	(1) To see that bolting up is properly done (2) To do flush riveting. (3) To exercise greater care.
(1) Knowledge of and skill in performing duties of a holder on	(1) Possibly some familiarity with ship conditions.
(1) Knowledge of and skill in performing duties of a passer	(1) Possibly some familiarity with ship conditions.
(1) Knowledge of and skill in using hand riveting tools	(1) Probably a man accustomed to hand riveting on structural work could do or could very quickly learn to do any hand riveting required in ship work. He may possibly need to learn the use of some special tools.

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Table XVI

Comparison of Shipwright and Kindred Trades Involving Use of Woodworking Tools

Trade names.		Work done.		Comparisons.	
Ship trade.	Kindred trade.	Ship trade.	Kindred trade.	Ship trade.	Kindred trade.
Shipwright or ship carpenter.	House carpenter or carpenter.	Laying keel blocks, moving keel blocks. Laying and moving bilge blocks.	Laying sills and foundations...	(1) Slope of grade line or declivity depends on weight and length of vessel (for launching purposes only). Some ships are built on a level keel fore and aft and athwartships.	(1) Grade or grade line is a horizontal line or grade established by the engineer above which heights are measured. A sloping grade line may be run for drains, pipes, etc.
		Shoring and framing.....	Bracing, blocking, and framing.	(1) Keel of ship is not level but inclined on a fixed slope or declivity in most cases. (2) Framing of ships is squared with the keel. (3) Frames of ship are steel (on steel ships). (4) Uses level, plumb bob, and declivity board. (5) No rafter cutting or roof framing in shipwork. (6) Ship carpenter builds no stairs and does no interior finishing, this is done by the ship joiner.	(1) Foundation of a building is level. (2) Framing of building is squared with foundation. (3) Frame of house is wood. (4) Uses level, plumb bob, and square. (5) Rafter cutting and roof framing are important. (6) House carpenter builds stairs, bookcases, cupboards, etc., and does interior finishing.
		Fairing ship and horning bulkheads.	Squaring frames, studding, columns, partitions, etc.	(1) Center line is carried up vertically from keel. (2) Base line is established. (3) Measurements are checked on center line and base line. (4) Bulkheads are horned or squared by plumb bob and declivity board and by measurements fore and aft.	(1) Lines are run for partitions, columns, studding, etc. (2) Building is plumbed and squared by level, plumb bob, and square.
		Laying wood decks and sometimes calking them.	Laying floors.....	(1) Deck is fastened with bolts or lag screws and must be made water-tight by calking. (2) Deck has fore and aft slope or sheer and side slope or camber. (3) Decking is heavier as a rule than flooring. (4) A deck seam is tight on the inside and open (for calking) on the outside.	(1) Floor is nailed and not water-tight. (2) Floor is usually flat and level. (3) House flooring is light. Heavier flooring may be required in warehouses, stores, etc. (4) A floor seam is tight on the outside.
		Boxing pipe..... Laying ceiling. (A ceiling in shipwork means interior wood casing for the floor, sides, or ceiling of a room, not merely overhead covering.) Putting on cargo battens. Installing wood foundations.	Lays floors and "ceils" rooms and puts on siding.	The operations are the same in the case of the ship carpenter and the house carpenter and the work is practically the same.	
	House mover.....	Building launching cradle and launching ways and launching ship.	No corresponding work done except the blocking and shoring done in raising or moving a building.	(1) A ship is wedged firmly in the cradle and lowered upon the ways by splitting out the keel blocks. (2) A ship slides down greased ways.	(1) A house is wedged up or raised by jackscrews and rollers placed beneath it. (2) A house is pulled along on rollers.
Stage builder.....	Bridge carpenters..... Rough carpenters. Dock builders. Piledriver man. Lumber jacks can be used for this work as well as the house carpenter.	Stage building.....	Building scaffolding, staging, trestle work, heavy timber framing for barns, docks, wharves, etc.	No direct comparison is necessary as the work is essentially the same.	
Sparmaker.....	No kindred trade.....	Spar making.....	No kindred work except general shaping of heavy timbers.	No direct comparison can be made. Spar making requires much more care and skill than the ordinary shaping of rough timbers. Much of the work is made to caliper measurements.	
Boat builder.....	Boat builder.....	Builds boats for ships.....	Builds boats, launches, etc....	Work is essentially the same in both cases.	
Calker.....	Calker on small boats and launches.	Calks wood decks.....	Calks seams on small boats and launches	The work is essentially the same but much heavier on ship work.	

Assets of man in kindred trade.	What he must be taught.
(1) Knowledge of skill in using woodworking tools..... (2) Ability to read blue prints..... (3) Skill in measuring and fitting..... (4) A general knowledge of timbers, bracing and framing. (5) A knowledge of and skill in using the level, plumb bob, and square.	(1) Terms used in ship construction. (2) The meaning of declivity and how to make and use a declivity board. (This is not necessary if the ships are built on a level keel.) (3) Proper method of placing shoring for strength and to keep ship fair. (4) Method of fairing steel frames. (5) Method of horning bulkheads by declivity boards, plumb bob, and fore and aft measurements (declivity board not used if ship is on level keel). (6) To cut and fit work on a bevel or slant. (7) To run grade and center lines. (8) To make water-tight jobs. (9) To use broad ax and adze.
What a house carpenter must be taught depends in a large measure on what kind of ship work he is expected to do. In such work as stage building, boxing pipes, and laying ceiling he would need little if any instruction.	
(1) As stated above.....	This is steelwork and entirely unrelated to the work of the house carpenter. It would require considerable experience to enable him to handle the work successfully.
(1) As stated above.....	(1) Terms used in ship construction. (2) To lay off holes for bolts or lag screws with batten and chalk line. (3) To handle heavy decking. (4) To work on sloping and not flat surfaces. (5) Method of housing or nibbing the ends of decking. (6) To make deck seams tight on the inside and not on the outside (for calking purposes).

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Table XVI

Comparison of Shipwright and Kindred Trades Involving Use of Woodworking Tools

(Concluded from preceding page)

(1) As above	This work could all be done by a house carpenter after receiving some explanations of ship conditions and becoming somewhat familiar with ship construction.
(1) Knowledge of methods of handling heavy timbers, wedges, and shoring. (2) Knowledge of heavy woodworking tools, ropes, winches, jackscrews, rollers, etc.	(1) Terms used in ship construction. (2) How to run line for slope of ways. (3) Care in cleaning, lining, and shoring ways. (4) Methods of cutting and fitting cribbing and blocking and wedges. (5) Methods of installing toggles and frapping. (6) How to use a broad ax and adze. (7) Duties on launching day.
(1) Knowledge of heavy timbering and staging. (2) Knowledge of heavy woodworking tools.	No instruction necessary except a slight explanation of ship conditions and requirements.
(1) Any man accustomed to shaping heavy timbers can probably use drawknife and plane.	(1) How to use a broad ax and adze. (2) Methods of accurately shaping large timbers. (Skill must be acquired by experience.)
An outside boat builder can do the work of a ship boat builder without further instruction.	
	Use of heavy calking tools and process of heavy calking. Handling of oakum is important.

Table XVII

Analysis of Trades in Steel Mill

Classes of work done.	Men required for each class.	Individual duties.	Jobs done.	Analysis of operations.
Angle smith	1 anglesmith	Bends and welds small lengths and light angular shapes.	Bends and welds tank frames, doorf ames, frame staples, bulkhead staples, etc., using molds furnished by mold loft or lifted from ship by ship fitters.	1. Takes molds furnished by mold loft or lifted by ship fitters and selects stock. 2. Marks stock where it is to be cut or bent with cold chisel. 3. Puts bar in forge and heats it. 4. Bend bar to shape of mold or cuts when necessary with hot chisel.
	2 helpers: (a) Hammer man	Strikes as directed by angle smith.		
	(b) Back handler	Handles material.	Welds	1. Cuts stock to proper length. 2. Reheats. 3. Shapes to point where piece is to be welded. 4. Heats to welding heat. 5. Welds. 6. Smooths up job with flatter. 7. Test with mold. 8. Hammers and shapes slightly if necessary.
Furnace man or frame bender	1 frame bender	Bends heavy structural shape working from molds.	Bends frames	1. Gets mold from loft or from fitter. 2. Lays mold down on bending floor. 3. Draws line around it on bending floor. 4. Measures back width of bar and draws second line. 5. Sets iron set or pins to this line. 6. Heats bar in furnace. 7. Draws bar out of furnace and makes one end fast with a dog. (In some cases center may be fastened instead of the end.) 8. Takes winder and bars and pushes free end around to the line or set. Bevels when necessary. 9. Releases bar and allows it to cool. 10. Hammers bar to final shape, fitting it to mold.
	4 or more helpers	Put in pins and dogs; put frames in furnace and draw them out; strike; use winder, bars, and other tools as directed by frame bender.		
Plate furnace man	1 plate furnace man	Shapes plates.	Shapes keel plates, boss plates, oxter plates and other plates requiring special work and heating to shape them.	1. Gets mold from mold loft or in special cases goes to ship and lifts it. 2. Makes cradle or frame of angles and plates to fit form of plate wanted. 3. Puts cradle on blocks or bending floor. 4. Heats plate. 5. Draws out over cradle. 6. Hammers with dolly bar and sledges. 7. Gives final shape after it has cooled somewhat as it curls away from the cradle when cooling.
	4 or more helpers	As above		
Machine operators on	1 operator	Operates machine and shapes work to fitter's layout.		
	2 to 4 helpers	Handle material and assist operator as directed.		
(a) Mangle			Straightens plates	
(b) Drill presses			Drill and countersink plates	
(c) Shears—				
Rotary			Cut curved plates	
Straight			Cut straight cuts	
Angle			Cut angles	
(d) Manhole punch			Punch large holes	
(e) Rolls			Bend or roll plates	
(f) Hydraulic jogging machine			Flange plates	
(g) Planers—				
Angle			Plane angles	
Plate			Plane plate edges	
(h) Friction saw			Cut-off shapes	
(i) Punches, horizontal, vertical			Punch holes	
(j) Acetylene torch	1 burner, works alone		Cuts out large holes which can not be punched	

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than the machine blacksmith. The machine blacksmith is more accustomed to close work. Dropforgers and tooldressers can do ship work without additional training. Wagonsmiths and carriagesmiths, sometimes called wheelwrights, can be used on the lighter and less difficult ship work. As a rule they lack breadth of experience.

Outside Machinist

The outside machinist erects machinery and equipment on the ship and operates machinery for trial purposes. There are in general three classes of work:

1—Engineering work comprising the installation and operation of the engine-room machinery, including main and auxiliary engines, pumps, piping, propeller shafts, propellers and bearings.

2—Hull work on valves, sea chests, fittings, etc.

3—Deck machinery, winches, capstans, steering gear, etc.

The work is closely connected with that of the shipwright and pipe fitter. Practice varies somewhat in different yards as to the work done by each. The corresponding outside craftsman is usually called an erecting man or road man. The work of the two is essentially the same, as are the tools and processes used. In ship work, however, the following special points may be noted. Long lines are stretched and located for propeller shafts in which the sag must be carefully allowed for. In ship work the level cannot be used as frequently as in outside work, because shafting foundations and bearings may not be level or horizontal. There are no vertical walls for which measurements may be taken; the space in which work is done is small and cramped and thus getting pieces into position is often difficult.

Desirable craftsmen for outside machinists are the erecting man on steam engines, turbines, machine tools, or any form of heavy machinery; erecting specialist on gas engines; millwright, erecting man on steam boilers; automobile, gas engine assembler or repair man; and elevator instructor.

Chipper and Calker

Wood calking has already been referred to as a distinctly ship trade, and a part of the shipwright's work (see Table IX). Metal calking is not a distinctly ship trade and is not a part of the shipwright work; but is usually associated with that of the chipper. The operation consists in wedging together the metal on both sides of a joint so as to make it watertight. The chipper and calker use the same style of air hammer, and before plates can be calked they must usually be prepared by chipping; consequently a calker must necessarily understand chipping. Chippers are often promoted to calkers as they gain in skill in handling the air hammer and tools. Hand chipping and calking are sometimes done.

The only work akin to that of the calker is the calking done by the structural steel workers on tanks and the calking done by the boilermaker on boiler seams. The purpose of the operation is in both cases identical, and in general the same tools are used. A boilermaker's work is somewhat heavier and requires greater skill and care. He uses the fuller and square tool, which are not used by the ship calker. Air hammer and hand chipping is done in foundries, machine shops, boiler shops and structural steel shops, often by helpers except on work requiring special care. The tools used and the operations are the same as in ship work. Stonecutters and quarrymen accustomed to using the mallet or air hammer and chisel are also adapted to this work.

Riveter

Of all the trades in shipbuilding in which there is a corresponding outside trade, the riveter is the most important (see Tables XII and XV). The building of a steel ship, whether it be standardized or not, is ultimately a question of driving rivets. A 7500-ton ship requires about 650,000 rivets. The best week's drive by any shipyard is that of the San Francisco Union Iron Works of 250,000 rivets. Other yards have driven approximately 200,000 per week. A good ship riveter must be able to drive rivets rapidly, cleanly and to make them watertight, using the long-stroke air hammer and in most cases a flush die. Hand riveting is seldom done. Bull riveting is done wherever possible, chiefly on nonwatertight work. In the yard, chippers and calkers are often trained as riveters, due to the fact that they are accustomed to handling an air hammer.

The best source of supply from the outside trades is the structural riveter, including the tank riveter. The main problem in training the structural riveter is not one of teaching the detail of mechanical processes. The structural riveter or erector is a high-spirited, energetic, pushing workman proud of his calling and loath to believe that he must be taught something new. By nature and training he is inclined to rush and to chafe at interference. The main problem is to teach him greater care in watertight work and at the same time not to destroy his inherent push and energy and desire to get the job done. Details of comparison of the ship and structural riveter will be found in Table XV.

Shipbuilding Trades Into Which the Outside Craftsman May Come Without Additional Training

The following trades are represented in outside work and shipwork, and practically no additional special training is required for shipwork: Machinist, boilermaker, diesinker, patternmaker, yard rigger and craneman, acetylene welder and burner, electric welder, molder, coremaker, driller and reamer, galvanizer, machine operators in steel mill or ship shed and painter.

The statement that no special training is required does not mean that the outside craftsman may be expected to handle immediately any and all classes of shipwork falling within his trade. It means that in these trades the same tools, processes and materials are used and under the same conditions as in the outside trades. There are special points to be mastered, as in every special class of work, notably in regard to size and quantity of product, as in the case of the molder, coremaker and galvanizer. The objection made by many shipbuilders to the outside craftsman is that he is "a specialist and not an all-round man". This objection has been most frequently made in the case of the sheet metal worker, boilermaker, molder and blacksmith, and to some extent in the case of the machinist. Another frequent objection made is that he cannot read blue prints, or is lost when put up against a ship blue print.

Offers Cash Prize

H. L. Aldrich, associate member of the council of the Society of Naval Architects and Marine Engineers, has offered $100 as a prize or prizes to the junior member or members who contribute the best written paper on the art of commercial or naval shipbuilding. The subject of power for driving ships is also to be included.

The papers are to be presented at the society's next annual meeting, which will be held in November. The object of the prize is to encourage junior members of the society to observe the designs as well as all details of ships and shipbuilding, to develop ideas of their own in reference to ship design and to enhance the value of the society to all concerned.

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What the Government is Doing

Rulings on Marine Matters **Improvements to Waterways**

Hints to Navigators

New Ships Must Have American Registry

ACTION has been taken by the war trade board, in co-operation with the United States shipping board, to insure that all the vessels turned out under the shipbuilding program, or otherwise, shall be registered as American vessels and thereby kept under the control of the United States government. In order to effect this, a ruling has been adopted by the war trade board, which will be incorporated as paragraph VI in general rules No. 1, governing the granting of licenses for bunker fuel, port, sea and ship's stores and supplies, and which reads as follows:

No application for bunkers by any vessel built in the United States and completed after Feb. 1, 1918, shall be granted, unless the vessel is documented under the American flag, or unless the United States shipping board shall have waived such documentation.

Governmental Approval Necessary

Clause O, paragraph V, general rules No. 1 above referred to, as amended Feb. 5, 1918, provides that no neutral or uncommandeered American vessel shall be bought or sold without the previous approval of the United States shipping board, the war trade board, or the inter-allied chartering executive.

In the application of this clause, O, the war trade board has issued the following announcement of the principles which will guide its action in the administration of this paragraph, which is to the following effect:

That applications for permission to buy or sell the vessels mentioned in clause O, paragraph V, should be made in the first instance to the United States shipping board, and that the war trade board would be governed by the decision of the United States shipping board upon such application.

For the further guidance of applicants for permission to buy or sell vessels under section O, the following rules of the shipping board have been issued:

Applications to the shipping board for permission to buy or sell vessels under section o, paragraph V of the war trade board's general rules number 1 should include the following information:

1.—Name of vessel.
2.—Official number.
3.—Date of construction.
4.—Type of vessel.
5.—Gross tonnage.
6.—Deadweight capacity.
7.—Speed.
8.—Name of purchaser.
9.—Citizenship.
10.—Number of years experience on the part of the purchaser in operating vessels.
11.—Trade in which purchaser proposes to place the vessel.
12.—Total price.
13.—Price per deadweight ton.

Under heading 9, attention is called to the following definition of a citizen of the United States, as given in section 2 of the shipping act approved Sept. 7, 1916:

That within the meaning of this act, no corporation, partnership or association shall be deemed a citizen of the United States unless the controlling interest therein is owned by citizens of the United States, and, in the case of a corporation, unless its president and managing directors are citizens of the United States and the corporation itself is organized under the laws of the United States or of a state, territory, district or possession thereof.

February Lake Levels

The United States lake survey reports the monthly mean stages of the Great Lakes for the month of February, 1918, as follows:

Lakes	Ft. above mean sea level Jan., 1918	Feb., 1918
Superior	601.93	601.71
Michigan-Huron	580.76	580.82
St. Clair	574.04	574.54
Erie	571.88	571.67
Ontario	246.07	245.98

Lake Superior is 0.22 foot lower than last month, 0.68 foot lower than a year ago, 0.07 foot below the average stage of February of the last 10 years, 0.77 foot below the high stage of February, 1901, and 0.95 foot above the low stage of February, 1871. During the last 10 years the February level has averaged 0.2 foot lower than the January level and 0.2 foot higher than the March level.

Lakes Michigan and Huron are 0.06 foot higher than last month, 0.44 foot higher than a year ago, 0.98 foot above the average stage of February of the last 10 years, 1.90 feet below the high stage of February, 1886, and 1.66 feet above the low stage of February, 1896. During the last 10 years the February level has averaged about the same as the January and March.

Lake Erie is 0.21 foot lower than last month, 0.32 foot higher than a year ago, 0.09 foot above the average stage of February of the last 10 years, 2.08 feet below the high stage of February, 1863, and 1.04 feet above the low stage of February, 1902. During the last 10 years the February level has averaged about the same as the January level and 0.10 foot lower than the March level.

Lake Ontario is 0.09 foot lower than last month, 0.90 foot higher than a year ago, 0.47 foot above the average stage of February of the last 10 years, 1.69 feet below the high stage of February, 1886, and 2.15 feet above the low stage of February, 1897. During the last 10 years the February level has averaged 0.2 foot higher than the January level, and 0.2 foot lower than the March level.

U. S. to Build Barges

The shipping board has recently decided to build a large fleet of barges and tugs to operate on inland waterways. The board announced that it had approved the recommendations of its legal department that the directors of the Emergency Fleet corporation properly can make an allotment out of the funds appropriated by congress for that purpose. About $3,600,000 is to be spent jointly by the chief engineer of the army and the general manager of the fleet corporation for building 24 barges and 4 tugs for Mississippi river service.

No. 2 bridge at the ore dock of the Canadian Furnace Co., Port Colborne, Ont., has been wrecked by a gale.

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Radio Problems Involve Much Study

Some Interesting Facts Are Given Concerning This Relatively New Science—Points to Consider in Installing Equipment

TO BE of value, a radio telegraph set must work when desired. Nearly everyone conversant with the subject knows that in the past radio sets have not always done this. To attempt to disguise this fact would be foolish, but no more so than the belief of many people today that radio is a little understood and unreliable phenomenon. Radio sets are like automobiles—ten years ago they were intricate, delicate, mechanically incorrect and little understood machines. Today they are simple, rugged and easily understood and any person of average intelligence can operate them.

In the past radio troubles came from a number of sources. In the first place, the radio apparatus of a few years ago was a high voltage, intricate machine which could be successfully operated and kept in working order only by a man of superior intelligence, training and experience. In the second place, a great number of boys and young men have become radio operators, not because of any great liking for the work itself, but because of the possibilities it offered for adventure. Consequently, powerful, intricate and delicate machines have often been operated by poorly trained men of inferior intelligence who regarded their work as a part of an adventure rather than a vocation.

Past Difficulties are Overcome

In the past, it has been considered a difficult problem to get radio sets to work in a satisfactory manner on small craft and it was generally considered that because of the limited antenna available, radio sets would never be used to any great extent on small boats. Many difficulties of the past, however, have been entirely overcome and at the present time radio sets are working successfully on boats as small as 45 feet overall on the Great Lakes and the Atlantic coast, regularly sending from 75 to 100 miles and more. The value of this achievement should not be undervalued because many of the United States government boats, submarine chasers for instance, are classed as small boats.

It is said that the distance a radio set will send depends upon six factors: (1) The size, measured in kilowatts, and efficiency of the transmitting set; (2) the type and efficiency of the receiving set at the station to which the message is sent; (3) the properties of the antenna, height, length and ground; (4) the character of the surface over which the message is sent; (5) the time of day or night, and year, at which messages are sent, which has to do with atmospheric conditions, and (6) the ability and efficiency of the operators at both transmitting and receiving stations.

The properties of the antenna, height, length and ground, are among

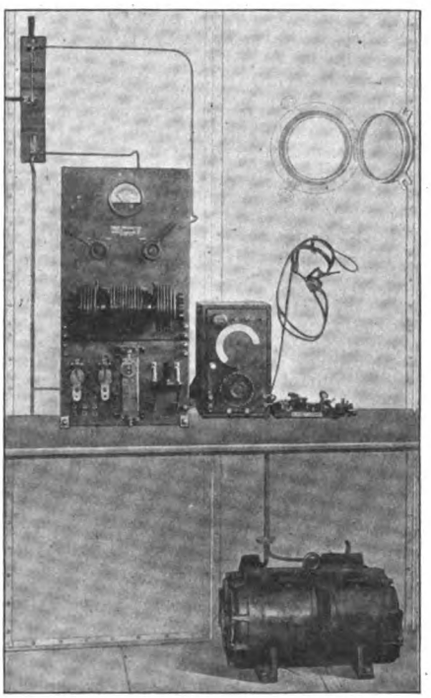

FIG. 1—COMPLETE RADIO APPARATUS

the most important factors controlling the distance which a radio set will send and receive. Antenna troubles usually come from one of two sources—either the antenna is too short or it is too long. On yachts and small boats the antenna, as a rule, should be as high and as long as it is practicable to make it. On unusually large boats it is possible to get the antenna too long. To avoid antenna troubles, it is a good plan to give complete information regarding the size of the boat, height of masts, distance between masts and other factors to the radio manufacturers before the installation is made. If this is done, trouble can probably be avoided.

The character and efficiency of the ground connection also materially affect the efficiency of a radio set. On wooden boats it is necessary to place some sort of metal on the outside of the vessel's hull to establish a ground. For this purpose, from 300 to 500 square feet of copper in the form of a strip or plate, which is connected to the radio room by means of a wire, is often recommended. With steel ships it is necessary only to connect the ground wire to the hull of the vessel. Any radio set installed on a steel ship will develop more radiation and work farther than it will on a wooden vessel of the same size because the steel hull forms an ideal ground connection.

Two other important factors to be considered in judging the distance a set will work are the character of the surface over which the messages are sent and the time of day or night, and year, at which they are sent. Any radio set will send farther over water than over land and it will send farther over salt than over fresh water. Again, it will send about three times as far over the Pacific ocean as it will on the Atlantic. Also, it will send from two to ten times as far at night as it will during the day and in temperate zones it will send much farther in winter than it will during the summer months.

Static Often Causes Trouble

To explain these factors in non-technical language is next to impossible. As a matter of fact, the reasons for some of them are not known. In the tropics the condition known as "static", which means an excess of electricity in the air, frequently becomes very troublesome. During these periods of excessive static it is usually not possible to work to any great distance except early in the morning. In the temperate zones, static conditions constitute a much less important factor and seldom cause serious trouble.

It is a fact not generally known that for the purpose of radio operation some men of supposedly normal hearing have much better ears than others. It has been noticed that one man can copy signals which other men cannot hear. Sometimes, with three men listening at a receiving set, one man will hear nothing at all, another will hear signals, but, because of their faintness, will not be able to copy them, while the third man will copy

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every word correctly. Some men can hear high notes much better than low ones, while other men can hear low notes the best. In transmitting, also, some operators are superior to others. Some men make their signals clearly and distinctly, while others get into slipshod habits and by clipping their dashes, cause much confusion and trouble. The best operator is the one with sensitive ears who sends evenly and clearly at the regulation rate of 20 words a minute.

The question of how long it should take a man to master the code is a difficult one to answer. Recently a young man, who had been a salesman and who knew nothing at all about radio telegraphy, was placed in the Eastern Radio institute, Boston. At the end of two weeks and two days he was able to copy perfectly 12 words a minute. Thus, after 41 hours of practice, he could, as far as the code was concerned, secure a second-class license. One man in the same school was able to copy perfectly 20 words a minute after he had been practicing only 10 days. This, however, is a very unusual record. It may be safely assumed that the majority of men, with competent instruction, can easily get up to 20 words a minute in less than 10 weeks' time, working 15 hours a week the meanwhile.

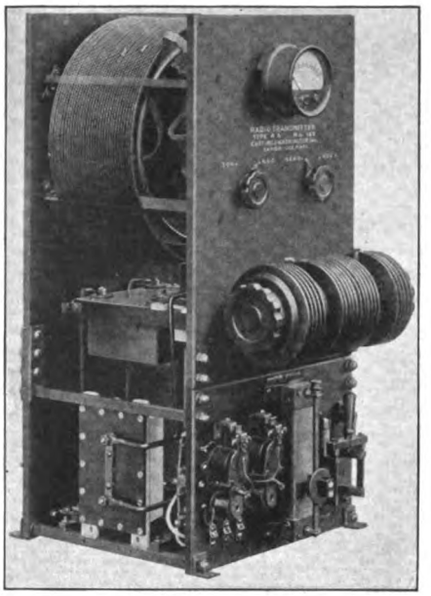

FIG. 2—A TRANSMITTING SET

The foregoing statements are taken from a booklet entitled "Radio Equipment", issued by Cutting & Washington, Cambridge, Mass. This booklet contains a great deal of practical information.

Fig. 1 shows a complete Cutting & Washington ½-kilowatt set as it appears installed aboard ship, ready for service, while Fig. 2 is a front view of the transmitting set which also appears at the left in Fig. 1.

What a British Humorist Thinks of Government Control

ENGLAND'S attempt to control her shipping evidently has not met with universal approval if the following glossary of nautical terms by the Liverpool, England, *Journal of Commerce* can be taken as a criterion. The *Journal* states that the list was compiled to enable cabinet ministers and politicians and other interested persons to expound the various aspects of the shipping question with precision and accuracy.

BOAT.—Anything that floats. Only profitable when controlled by government officials, who preferably ought to be schoolmasters or statisticians.

BREAD.—High cost of, entirely due to shipowner.

CAPITAL.—If invested in shipping a return of 2½ per cent should be ample; if invested in cocoa or beer, special circumstances must be considered.

DIVIDENDS.—Shipping company dividends vary from 100 per cent to 800 per cent. Decrease during bad years, some of the large companies only paying 80 per cent (see law on fifty years of shipowning, or 5000 per cent in my pocket, untaxed).

CHARTER.—An agreement under which the shipowner by transferring the control of the steamer seeks to relieve his conscience by diminishing his wealth.

CONTROL (governmental).—A complex affair. A subtle scheme under which the public is prevented from supplying shameful profits to shipowners by paying the government 400 per cent more in freight rates than they formerly paid to shipowners. The great thing to remember is to continue to hold the shipowner responsible for high cost of living. After all, the shipowners originally had ships built, and they must remain responsible.

FREIGHTS.—A damnable invention of the shipowning classes; the primary cause of the Russian collapse, or of any other untoward circumstance, such as floods in China, etc.

GOVERNMENT.—High-souled citizens, deeply averse to any dividend except five per cent on their own investments. Aware of iniquity of shipowners, but need constant urging.

LAW (admiralty).—Very complex, must be discussed with care.

MILLIONAIRE.—See shipowner.

MONEY.—Shameful profits according to law, to be found only in the pockets of shipowners.

NATIONALIZATION OF SHIPPING.—The great scheme to develop our mercantile marine after the war and to secure the carriage of commercial products free of charge. Would substitute dynamic driving force of government departments and super-efficiency of government officials for the fatuous lethargy of our privately controlled shipowning concerns. Very popular with provision merchants, plumbers, publicans, and chambers of commerce.

SHIPOWNER.—Social outcast; plutocrat (very bloated); blinder of the faces of the poor; parasite; heartless profiteer; always a millionaire; entirely destitute of patriotic feeling; real instigator of this war; the terms shipowner, shipbuilder, shipbroker, shipwright, shipping firm, firm of shippers, etc., can be used indiscriminately as synonyms.

SHIPOWNING.—The royal road to vast and immediate wealth.

TAXATION.—A method invented by law whereby it is made more profitable to clear out of (shipping) business than to remain in it.

TONNAGE.—A vague term; little information about tonnage except that it is saved by doubling the prices of newspapers.

WAGES (High).—Forced upon the country by the action of shipowners.

WAGES (Low).—Necessary owing to high freights imposed by shipowners.

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West Coast Solves Labor Problem

Modern Machinery Now Used to Eliminate Hand Labor—Activities of the I. W. W. Have Practically Ceased—Men Are Satisfied

By W. D. B. Dodson
Executive Secretary, Portland Chamber of Commerce

THE actual facts regarding labor conditions for the building of ships of either wood or steel in the Pacific northwest have been very greatly exaggerated. This applies especially to Portland, where there has been but one strike of any moment whatever affecting the industry.

The origin of the bad reports as to the labor conditions is found in what is known as the I. W. W. disturbance in the logging camps of the Northwest during the spring of 1917. A small percentage of the labor employed in logging operations had been won over to the I. W. W. beliefs at the time America entered the war. These people were avowedly against the government, against the established order of things, against the industry and against everything that our people were undertaking to do to uphold the national administration in its struggle. Their demands as to time, wages, and other conditions were held prohibitive, and, in fact, their leaders admitted they were not made with the expectation of being granted, but more as a declaration against everything in the existing order of society.

This situation was not serious if it had been met promptly and vigorously. There were army officers on the Pacific coast who said they would stop I. W. W. interference within a week's time if given the power. The local people, working through vigilance committees, probably would have been able to accomplish the same end quickly had it not been for the fact that such procedure is unlawful and would involve otherwise law-abiding men in prosecutions which were threatened in the most drastic form by national officials.

Mistaken Toleration

Through some mistaken policy as to toleration, the I. W. W. was permitted to interfere seriously in the logging camps of the state of Washington for a few months which crippled the production of logs needed for the manufacture of lumber used in building ships. Their numbers were not so serious as their methods. Small groups would menace laborers who did not care to subject themselves to violence and bloodshed and mingle in a disorderly, riotous conflict. After considerable delay the government took action against the I. W. W. and whatever menace this negligible organization had against industries in the Northwest practically disappeared immediately. The only remnant of that trouble confronted today is what is declared a species of sabotage, in which the I. W. W. is alleged to be teaching its members to resume work and then clandestinely and at various opportunities injure machines or vital parts of the plant in such a way that the origin of the trouble cannot be detected. Only a limited number of men have been interested in such an unpatriotic and cowardly effort, and this also may be stopped quickly as soon as the proper energy is applied to the case by the federal authorities, or as soon as the license might be recognized by local people to take the question in hand by primitive methods.

The trade union movement has taken no other form to affect our work in the national program than making demands for increased wages, which the employers often thought impossible to grant, and also striking, occasionally, in an effort to compel labor employers to concede to union demands. This demand was presented first in respect to the hours and wages of the laborers in lumber mills. The northwestern lumber mills today are on a 10-hour basis. They find their brethren who compete for the lumber market of the country in the yellow pine districts of the South on a 10 and an 11-hour basis. The operators of the Northwest also find that they are today paying a wage 50 per cent above that paid for common and skilled labor in the mills of the yellow pine territory of the South. Being competitors for business in Missouri river points and certain territory of the middle west, Pacific coast mills hold that they cannot grant further wage increases and a shortening of hours, thus limiting production, except by eliminating themselves from certain competitive fields.

Officials Change Attitude

Governmental agencies sent to the mills in the early days insisted that west coast sawmills had to recognize an 8-hour day, regardless of competitive conditions elsewhere. The mills resented this attitude and declared they would close before they would accede unless the government made competitors do likewise. Later the government agencies have taken a broader view and have not undertaken to exercise a pressure for a condition regarded as manifestly unfair.

Trade unionists in Puget sound, who were working on ships, refused to receive lumber made in mills where a 10-hour day and an open-shop basis prevailed. This resulted in a few strikes. About 98 per cent of the sawmills of this territory signed an agreement that they would not close the shop or grant an 8-hour day until their competitors did likewise. This resulted in delay in securing the raw material needed for building wooden ships on Puget sound and at Grays harbor. On the Columbia river the trade unions engaged in building wooden ships where open-shop conditions prevailed quite universally, did not take the same stand as those on Puget sound. There has been no delay in delivery of the timbers needed for wood shipbuilding in Oregon.

As to the quantity of labor in the

(*Concluded on page* 166)

Give Us More Ships

We must have ships and yet more ships to transport our troops abroad and to keep them supplied with the vital necessities of modern warfare. To build ships means the employment of a vast army of workers under conditions tending to create perhaps more than the usual friction between capital and labor. When our wooden shipbuilding plan was first put into operation, the shipbuilders of the Pacific Northwest faced serious labor problems which they have solved successfully. The I. W. W. menace which threatened to assume serious proportions has been suppressed. The author of this article, W. D. B. Dodson, is executive secretary of the Portland, Oreg., chamber of commerce and therefore he is in a position to treat his subject from first-hand knowledge.

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Latest Marine News in Pictures

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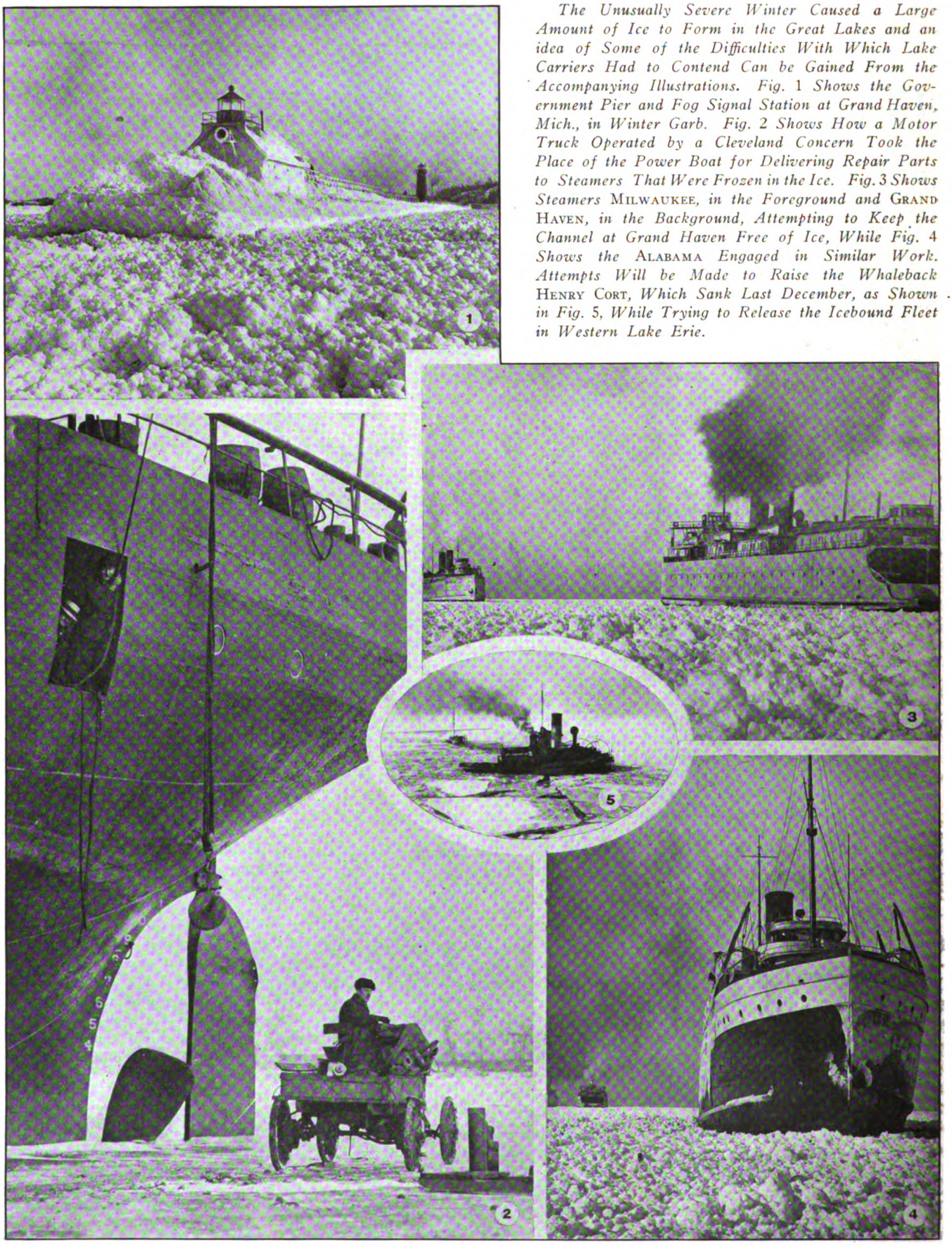

The Unusually Severe Winter Caused a Large Amount of Ice to Form in the Great Lakes and an idea of Some of the Difficulties With Which Lake Carriers Had to Contend Can be Gained From the Accompanying Illustrations. Fig. 1 Shows the Government Pier and Fog Signal Station at Grand Haven, Mich., in Winter Garb. Fig. 2 Shows How a Motor Truck Operated by a Cleveland Concern Took the Place of the Power Boat for Delivering Repair Parts to Steamers That Were Frozen in the Ice. Fig. 3 Shows Steamers MILWAUKEE, *in the Foreground and* GRAND HAVEN, *in the Background, Attempting to Keep the Channel at Grand Haven Free of Ice, While Fig. 4 Shows the* ALABAMA *Engaged in Similar Work. Attempts Will be Made to Raise the Whaleback* HENRY CORT, *Which Sank Last December, as Shown in Fig. 5, While Trying to Release the Icebound Fleet in Western Lake Erie.*

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Photographs From Far and Near

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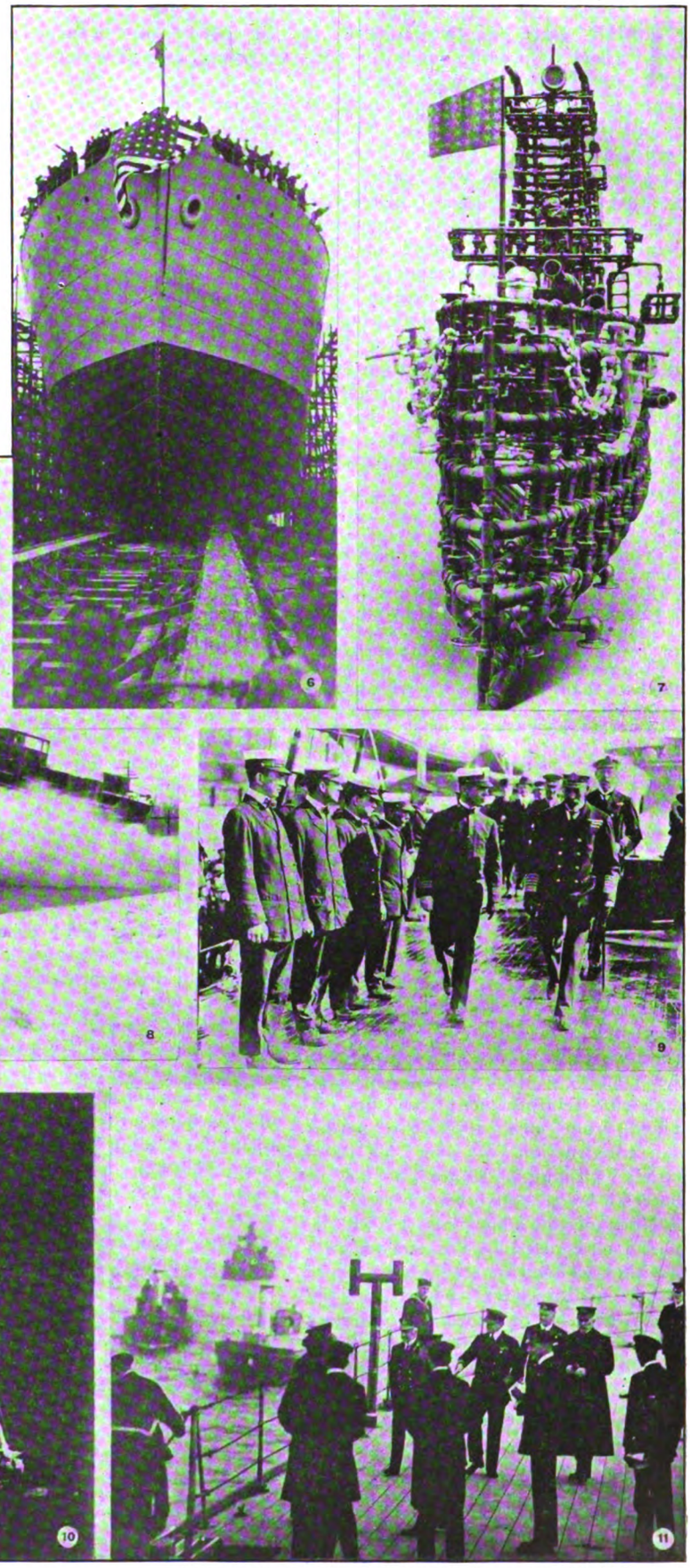
Fig 6—WESTERN KING, *the First Vessel to be Launched on Puget Sound in* 1918. *She will be taken Over by the Emergency Fleet Corporation. Fig. 7—Unique Model of a Battleship Built Entirely of Pipe Fittings of Which* 6669 *Separate Pieces Were Used. Fig* 8—*Launching the* WAR DUTY *at Chicago—Another Vessel for Uncle Sam. Fig. 9—King George V Visits an American Patrol Ship in the War Zone. Fig.* 10—*A Burning American Schooner Sighted Off St. Nazaire, France. The Ships of the Allies Hesitate to Go to the Rescue of Burning Craft Because the German Submarine Commanders Have Adopted the Decoy of a Ship in Distress to Lure Their Prey Within Torpedo Distance. Fig.* 11—*Admiral Benson, Chief of Operations of the American Navy, About to Leave Flagship of Admiral Beatty, Commander of England's Grand Fleet.*



Figs. 9, 10 *and* 11 *copyrighted by Comm. on Pub. Inf.*

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To Build Concrete Barges

Carriers of 150-Ton Capacity Being Considered by New York For Use on New Canal

THE state of New York is asked to provide funds for constructing a fleet of reinforced concrete barges for its new canal in a bill introduced by State Senator Henry M. Sage. The pending bill has been indorsed by Spencer W. Stewart of the Ambursen Construction Co., New York, who has submitted plans for a 150-ton barge to Maj. Gen. W. W. Wotherspoon, state superintendent of public works.

Mr. Stewart cites the following as demonstrated facts to Senator Sage in support of his contention that reinforced concrete barges should be built instead of wood or steel barges:

Reinforced concrete was first used abroad in this class of construction in 1849.

Reinforced concrete barges have been in successful commercial use in the United States for about six years.

Properly designed and proportioned concrete is waterproof and permanent.

Concrete barges are rat-proof, rot-proof, fire-proof, and time-proof.

Concrete barges require practically no repairs, painting, or maintenance.

Concrete barges can be produced quicker than any other type of construction.

Concrete barges now cost less than the final cost of good timber barges.

Concrete barges are better for power equipment because of no vibration.

Materials Easily Secured

He points out that "the principal materials employed are sand, gravel, cement and steel bars. Sand, gravel and cement can be delivered by barge, and the steel reinforcing comprises less than one carload per barge. Thus there is no burdening of already congested transportation systems nor interference with present demands on the country's steel output. In fact, sufficient reinforcement can be obtained from local stocks to permit the construction of over 50 canal barges without a single carload of material being delivered by rail.

"None of the labor required will be of the class used in the construction of either wooden or steel ships. There will be no carpenters required, as the forms will be of especially designed steel sections and will be placed by unskilled labor under a trained foreman.

Building Cost is Low

"The speed of construction, the character of materials used, and the availability of designing and constructing organizations make it possible to build these barges at a cost that compares very favorably with the cost of wooden barges of equivalent carrying capacity, not even considering the fact that they can be put into service and become productive of revenue within three months' time.

"With a shipyard of only moderate size, it is possible to launch two completed barges a week three months after beginning work.

"In designing these barges the most severe conditions of loading and unloading have been considered and all reinforcement has been so proportioned that all stresses are well within customary limits for concrete work subject to similar loadings."

The Ship That Foundered Herself

(*Concluded from page* 143)

Time went on; the engines were installed in the sailing ship; her upper spars were lopped away; twin screws were fitted underneath her stern; the old rudder was rehung, and she was sent to sea. She carried little cargo, for the new engines and bunkers filled the main part of her hold.

But what need to relate the talk that went on among her parts while the fine old ship disintegrated under the unfamiliar strains? At best there was not much of it, for seamanship talks least when it has most to do. What was left of the ship settled down grimly to business.

"Hold up against me, garboard strake," said the starboard bilge planks. "There's a leak springing between us here."

"I can't, I can't," groaned the garboard strake. "It's these frames—they're pulling away from the keelson."

"We can't hold on, we can't hold on!" exclaimed the frames. "We have asked the keelson to pinch us and sit down hard on us, but, it's no use. Look out! We can't hold on much longer!"

"These engines are tearing the ship away from me," groaned the keelson. "Steady, frames! I'm holding you as tight as I can. But you have no idea of what I'm bearing on my own account. I've got this fore-and-aft strain on my hands. The damned contraption is trying to break the ship in two."

"It's simply hell out here," announced the rudder. "I can't either see or think straight—it's just an infernal jumble of water and foam. The stern-post tells me that he isn't too sure of holding the stern together. These twin screws seem to be trying to whirl their way into the lower hold and carry the stern along with them."

* * * The end came before long. There was little talk among the parts of the ship—only a few gruff "Goodbys". They understood each other. They had done what they could. And this is the end of the story about "The Ship That Foundered Herself".

West Coast Solves Labor Problem

(*Concluded from page* 163)

state of Oregon there has never been any shortage for shipbuilding operations. The greatest abundance of this labor, of course, is in the unskilled and partly skilled classes. With skilled labor there has been some shortage. This is being met in a remarkably effective manner in two ways: First, by the use of machines that eliminate a large amount of labor in preparing timbers, such as the tilting bandsaw, the tilting planer, mechanical caulker, etc., and, second, by training men skilled in some trade for specialized shipbuilding work.

Delays Not Wholly Due to Labor

We believe the chief delays in building ships in the Pacific Northwest are not wholly chargeable to labor, but in part to the changes and uncertainties of policy on the part of the shipping board. One administration desired to build wooden ships with great rapidity. The placing of orders for wood ships progressed satisfactorily for a while; then they stopped. The next administration announced no more wood ships. Then we fought to build for friendly foreign account where the shipping board did not want the type of craft. Weeks and months were lost in trying to get this privilege granted. What we cannot understand is, when ships are such a vital need to the allied cause, why we should not be permitted to bend all energies to the building of all the ships that we possibly can if they are to be used by either our government or allied countries to help win the war. We also are unable to understand why sectional prejudices should be permitted to enlarge little difficulties and why these exaggerated and overstated difficulties should be permitted to continue a serious impediment to the supplying of an absolutely vital need to the allied cause.

William J. Wood, naval architect, Chicago, has been appointed inspecting naval architect, division of wood ship construction, United States Shipping Board Emergency Fleet Corp. Mr. Wood's office is at 1029 Munsey building, Washington, D. C.

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Navigating in the "Roaring Forties"

A Story of Experiences on One of World's Longest and Most Lonely Sea Passages —Description of Famous Albatross Route Along Southern Hoops of the Earth

By Capt. George S. Laing

TO DEEP sea navigators, "Roaring Forties" is an expression which teems with reminiscent exploits and brings back vivid recollections of one of the world's most famous sea passages—the Albatross route. This continuous run in an easterly direction along the lower hoops of the southern hemisphere is known to many steamboat men and all sailing shipmen of foreign-going craft. There are two sections of this wild and lonely ocean highway. The most traveled section is that part of open water beginning at Tristan da Cunha island in latitude 37 degrees 3 minutes south and longitude 12 degrees 18 minutes west and extending to New Zealand. Great circle courses, according to the chosen parallel of latitude, will put the distance between these two places at approximately 8000 miles.

Vessels bound to India, China or Java leave the trail according to the monsoons that await them in the tropics, while those who are bound to Australia or New Zealand keep right on till they have in some cases made a complete half circle on the globe, having sailed or steamed through 180 degrees of longitude.

Measures 7000 Miles

The other section of the Albatross route is the sweep of the southern Pacific ocean that spans between the Antipodes and the rock bound coast of Chili. This run, say between Melbourne and Valparaiso, meas .res nearly 7000 miles. The track shown in the accompanying chart marked "Maggie Dorrit" is a common one when going to Australia. Some craft go farther south and take more chances with ice, while low-powered tramp steamers in ballast from the cape of Good Hope are best handled on the north edge of this track. It must be remembered that in steamers of this latter type, a heavy following sea, such as one finds in the open waters on this run, causes very lively racing of engines and screws. With sailing ships they are supposed to "run" before any sea that Neptune sends along, and many of the smartest day run's in the history of sail have been rolled out on this famous track.

The Albatross Route

With cyclonic gales piping out of the west
And hills of green sea smoking white
Our ship rolls along to a harbor of rest
In the shade of Australia's Great Bight.
With waist all awash and spars almost bare
And foresail clews wet in the foot
She churns the ocean 'neath Crucis bright flare
Heave taut for the Albatross route!

In the N. E. monsoons vessels bound to the bay of Bengal will leave the "Maggie Dorrit" track when on the meridian of St. Pauls or Amsterdam islands, while craftbound to China under canvas will shape for the N. W. cape in Australia from about the same longitude. The most popular parallels of latitude to keep between are from 42 degrees S. to 46 degrees S., and the two main reasons for going down into this heavy weather track are, first, the prevalent gales are westerly, second, the degrees of longitude are considerably contracted. The "Maggie Dorrit" track shows that the vessel had frequently to keep "dead before it" when quarterly wind and sea became too heavy, hence the ungraceful curve. In such a long and open run it is much more advantageous to "keep her away a couple of points" than court damage from quarterly seas or perhaps spring a top-gallant mast or yard through "gripping" to windward.

Fails to Affect Popularity

When the Suez canal offered a carpet slipper route to the Orient, the building of tramp steamers made the partial disuse of the Albatross route seem imminent, but this famous track will be popular as long as the earth revolves. Even cutting the string at Panama and separating the two Americas will make a very slight difference in diverting tonnage, both steam and sail, from the "Roaring Forties."

Only a few years ago the writer as an officer made the trip from New York to Hongkong via the Cape of Good Hope, owing to the steamer—the ANGLO-AUSTRALIAN—being of the hurricane deck type that is heavy on dues in the Suez passage. A few points concerning this run in steam may be cited. We carried 3500 tons of oil in can and case form. With the exception of six hours at Singapore in Malacca straits, where we coaled for the first time, the main engines never stopped. Thus a distance of 12,000 miles was covered with-

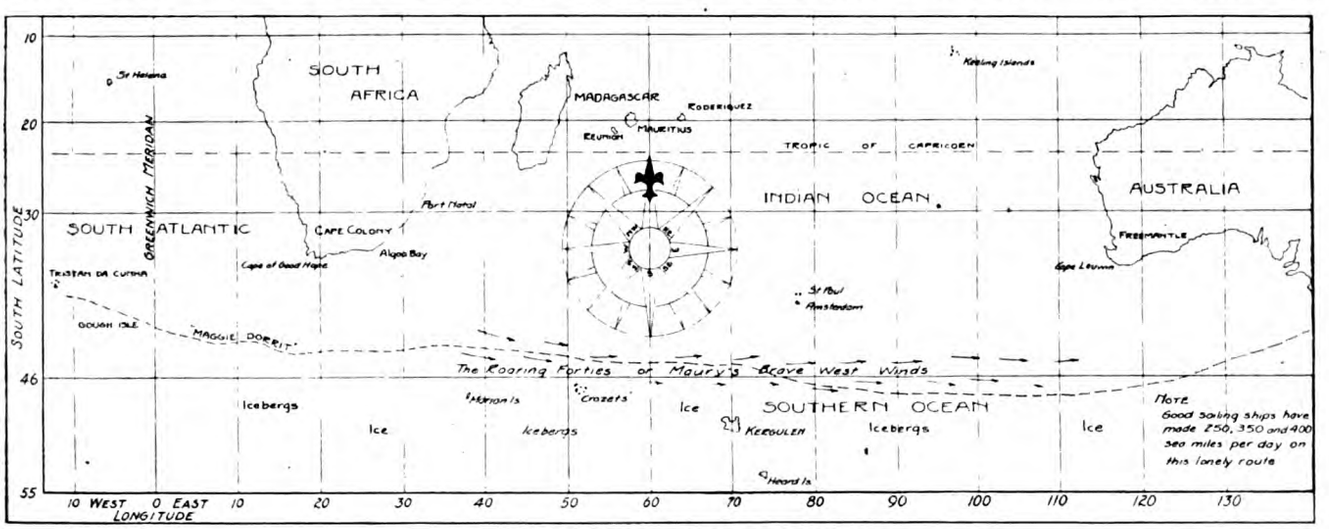

CHART OF THE ROARING FORTIES

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out starting a hatch wedge or seeing the land till we raised Anjer in Sunda straits. The time from New York to Hongkong, 13,500 miles, was 59 days, an average daily run of 228 miles on a total consumption of 1800 tons of coal—Pocahontas. For a tramp steamer this shows easily what can be done in long runs. As a general rule most of the ocean steamers must get in touch with a coal mine every three weeks or put out a sea anchor.

In this steamer we coasted from Hongkong to Rangoon, loaded rice, and sailed for Valparaiso. During this interesting passage we coaled up at Mount Kembla, near Sydney, Australia, and then made the run over the second section of the Albatross route, from the Antipodes to Chili, where our ship was eventually loaded again for France and England, which were originally our starting points. We had then circumnavigated the world and had handled only three cargoes, for we crossed the North Atlantic in ballast. The voyage took 11 months. In "Running the Easting Down" our only mishap was in 50 degrees E., where on leaving the track a very heavy sea smashed in a teakwood door of our midship cabin, flooding the dining saloon.

However, all the accidents which can possibly befall a vessel may happen on such long and lonely runs. Fire from spontaneous combustion, collision with icebergs, dismasting, losing men overboard, cracking cylinders, breaking shafts, throwing blades or buckets off the propeller, etc., etc., and there are no ports of refuge to fall back on. Most of the time that a ship is on those tracks she is a thousand and one miles from everywhere. From four to six weeks constant pegging before fresh gales and high seas is a common part of the trip, Fog is not prevalent.

Provide for Wrecked Seamen

The scattered islands on the route are visited by whalers, and some are provisioned for the specific use of shipwrecked seamen who may land there in their open boats from the abandoned parent vessels. Stores of blankets, clothes, biscuits, meats, and an assortment of handy tools, nails and matches, etc., etc., are put up in weather-proof casks and well covered with tar and sand to keep out the salt air. It is a criminal offense to broach these goods unless in dire necessity, and when they are used the vessel in question has to notify the consular authorities at the port to which the shipwrecked crew eventually find themselves. Nearly every year an Australian or French man-of-war visits these ocean out-posts and picks up any stray crews that may be cast up on the inhospitable rocks. If stores need replenishing that opportunity is also made use of.

To write on this subject without saying a little about the most wonderful sea birds in the world would be calamitous, for the giant albatross makes his home in the "Roaring Forties" of south latitude. His feathered companions are the molly-hawk, cape hen and cape pigeon. These birds seem to detest the land for they can always be seen in the loneliest parts of the track. Indeed the same birds follow us for weeks and weeks and they must frequently make the trip from Cape of Good Hope to Australia and New Zealand. With the exception of about two months a year when they alight on the barren reefs of St. Paul or Amsterdam islands to breed, they spend their lives at sea. And at no time is the track absolutely deserted by the feathered crew.

We sometimes kill the albatross for his flesh but it is not good eating. Ten to 14 feet is a common stretch of wings and the breast makes a good muff. The head and wings are used in a decorative way, and the grease is used as a dubbin, while the bones make good pipe stems.

New Orleans to Have a New Ship Canal

By Harry H. Dunn

NEW Orleans has decided to begin work immediately on a ship canal, running directly across the city and connecting the Mississippi river with Lake Pontchartrain. Demand for shipyard sites in water deep enough for the construction of wooden and steel ships of at least 3000 tons; need of a quiet harbor away from the treacherous current of the river, and the apparent value of a shorter waterway into the gulf than that offered by the 110 miles by river from the city to the passes, were the principal causes for the decision to build the canal.

Five banks, four in New Orleans and one in Chicago, have agreed to purchase the $3,500,000 bond issue estimated to be necessary, and to stand ready to take another $1,000,000 if this is needed.

Borings to avoid quicksand and to find a clay foundation are being made along the bank of the river, with the probabilities, according to engineers, strongly in favor of a site on the lower side of the city, somewhere near the Chalmette slips, where, for a considerable distance, the Public Belt railroad runs along what is considered a desirable right-of-way for the big ditch. Nothing as to the location will be given out, however, until the engineers have made final selection.

The canal will be about five miles long. It will be at least 800 feet wide in the basin planned just back of the locks which will give into the river, but narrowing to 300 feet for the greater part of its length. Minimum depth will be 18 feet, but this may be increased to 32 feet, before the final plans are accepted. Engineers consulted said the canal, lock and turning basin can be constructed in a maximum period of 15 months, at a maximum cost of $3,200,000.

The canal will provide not only a waterway across New Orleans, but 10 miles of shipyard and warehouse sites, along which boats can be loaded direct from cars handled by the Public Belt railroad, which now girdles the waterfront, linking every pier with the main trunk lines of railroads which enter the city. In addition the new canal will be connected with the New Basin canal, the Old Basin canal, Bayou St. John canal, and the other canals which penetrate to the heart of New Orleans from Lake Pontchartrain.

The canal will also relieve the main harbor of a great deal of small-boat traffic, which now occupies at least two large wharves. These will be released for deep-sea shipping. Also, the canal will provide an inland waterway to the gulf nearly 40 miles shorter than the present way down the Mississippi.

Centrifugal Pumps

The Morris Machine Works, Baldwinsville, N. Y., is building a complete line of centrifugal pumps of standard design, adapted to belt or direct drive. A recent catalog shows the lighter types suitable for marine use, as well as heavier pumps for hydraulic dredging. An installation of the dredging equipment for the New York State Barge canal is shown. The dredging pump in this instance has a suction and discharge of 20 inches, and is directly connected with a 1000-horsepower engine.

A line of vertical marine engines ranging from 3 to 90 horsepower is manufactured by this company. These engines can be furnished with either side or piston valves as desired. A complete line of propellers of various types and sizes also is offered.

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South Launches New Type of Ship

A 4700-Ton Wooden Ship Recently Launched at Orange, Tex., Embodies Many Original Features — Diagonal Strapping is Designed to Insure Durability

By H. H. Dunn

A NEW type of wooden ship, exceeding the Ferris-plan vessel in tonnage, yet requiring 250,000 feet less of lumber in its construction, was launched by the National Shipbuilding Co., Orange, Tex., Feb. 27, when the WAR MYSTERY slipped down the ways. If the prediction of designers and builders is realized, this ship will end any controversy as to the practicability of the wooden vessel, and will solve any problems that have hampered construction of this class of freight carrier.

The WAR MYSTERY is the largest wooden steamship ever built. She is the first of two vessels contracted for with the Texas firm by the Cunard Steamship Co. The second, which is practically complete and will be launched about the end of March, will be christened the WAR MARVEL. On the ways in the yards of the National Shipbuilding Co., Orange, are six other vessels of the same type, which are being rushed to completion under the government contract, calling for a total of 12 ships. The first of these will be launched shortly after April 1, and the others will follow at short intervals. The WAR MYSTERY, just after launching, is shown in Fig. 5.

Differs from Ferris Type

There is radical difference between the WAR MYSTERY and the Ferris type of wooden ship adopted by the Emergency Fleet corporation as the type of vessel best adapted to conquer the submarine menace. One of these differences—in fact, the great difference—is that the WAR MYSTERY has a deadweight carrying capacity of 4700 tons, as against the 3500 tons of the Ferris model. In spite of this larger carrying ability, the WAR MYSTERY requires less than 1,500,000 feet of lumber in construction, while the Ferris model uses 1,750,000 feet.

Another feature which greatly facilitates construction and rapid production of ships of the WAR MYSTERY type is that they require no timbers of extraordinary size or length, leaving the demand such that the southern lumber mills are able to supply easily and quickly any quantitiy of material desired. Southern lumbermen have insisted that if there has been any delay on their part in supplying material for the Ferris-type ships, it has been due solely to the requirements for timbers so large and long that it was next to impossible to find them in the southern pine forests.

The WAR MYSTERY, which is identical except in a few minor details with all the wooden vessels being constructed by the National Shipbuilding Co., has a length over all of 315 feet, and a length between perpendiculars of 300 feet; a molded depth of 28 feet 6 inches; molded beam, 48 feet; beam outside planking, 49 feet 7 inches; draft, 24 feet. She is built throughout of dense southern yellow pine, with the exception of stem and stern posts and engine bearers, which are oak.

Hull is Diagonally Strapped

Among the original features embodied in her construction are: Frames of built-up timbers, scarfed and tied together with machine-driven hardwood treenails. Directly upon the outside of the frames and continuing uninterruptedly beneath the hull on top of the keel is nailed a double layer of diagonal strapping of material 1¼ inches thick and 9 inches wide. This construction is shown in Fig. 1. These diagonal courses are laid at right angles to each other and are designed to aid in giving the vessel extraordinary rigidity and strength, offering resistance to tension, compression and strain from every angle. The outer, planking proper, shown in Fig. 3, varies in thickness from the garboards, where it is 8 inches, to 5¼ inches on the vessel's bottom, and 4¾ inches on the sides. The sheer strake is 7 inches in thickness. Inside the vessel is ceiled throughout with 7-inch planking.

The vessel has a comparatively light keel—9 inches. The bottom of the ship has a floor of solid timbers, laid three deep and totaling 36 inches in thickness. The keelson is a steel plate 5 feet wide running the entire length of the vessel, and on which is mounted a fore-and-aft wood girder 18 inches deep. The bottom of the ship is further reinforced with additional keelsons of wood, 15 inches square, one at the turn of the bilge and the other midway between the bilge timber and the metal keelson. The heavy timbers in the vessel are fastened with screw bolts, instead of the clinch bolts frequently used. The largest single sticks required in the construction of this vessel are the deck beams extending from side to side. These are 48 feet long and 15 inches square.

The vessel will be driven by a 1450-horsepower triple-expansion reciprocating engine, with water-tube boilers. Another variation from the Ferris ship type is the location of the machinery, which in the WAR MYSTERY is well toward the stern rather than amidships. This arrangement leaves the cargo hold as one unit, and this, with three unusually large hatches, as shown in Fig. 4, will make loading and discharging cargoes exceptionally easy.

The vessel is not intended to carry sail, and the spars are derrick masts 45 feet high, built to fold down upon the deck, so as to lessen the visibility of the ship and reduce the danger of being accurately located at a distance by enemy vessels. The WAR MYSTERY and her sister vessels of her type have been given on A1 rating by Lloyds. The officers of the National company say they can produce a ship of the WAR MYSTERY type within 30 days after construction begins, and since the company has ways for eight vessels, the future production will be at the rate of 32 ships annually.

Yard Equipped in Short Time

The work already accomplished at the National yards is a remarkable example of speeding up to meet urgent war needs. On May 1 last year the site of the shipyards was the boggy, reed-grown shore of a river. Today it is fully equipped with everything needed in the way of machinery for modern shipbuilding, is already well on its way to the production of eight ships complete, and has a trained working organization of more than 900 men exclusive of master mechanics and directing supervisors. Six ships of the WAR MYSTERY type in process of construction are shown in Fig. 2.

The owners and directors of the National Shipbuilding Co. are for the most part men largely interested in oil, and when the installation of a shipyard at Orange, Tex., was first undertaken the purpose was to build steel oil tankers, an intention that was abandoned, temporarily at least,

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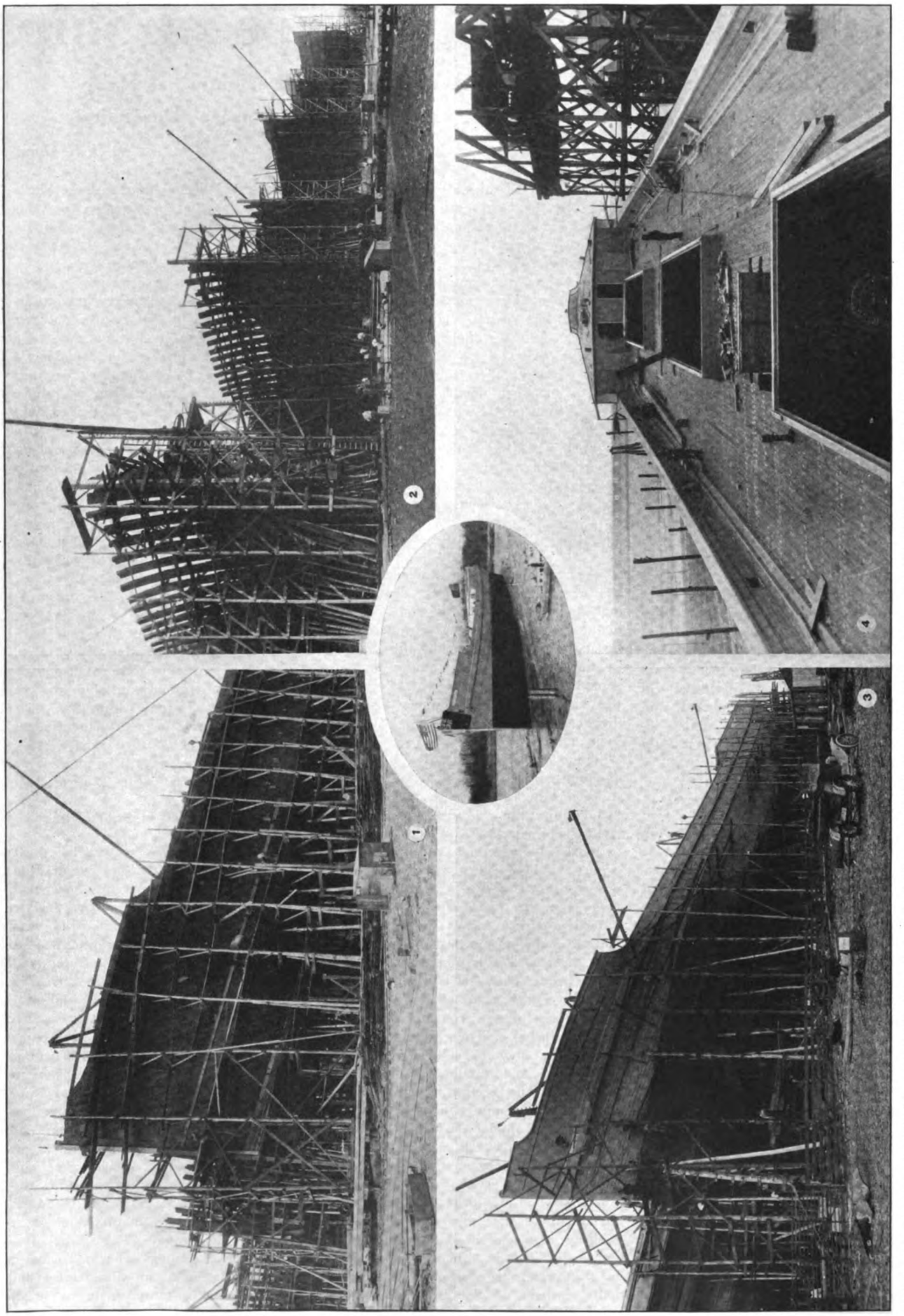

FIG. 1—DIAGONAL STRAPPING OF YELLOW PINE DIRECTLY UNDER THE PLANKING—FIG. 2—SIX VESSELS OF THE WAR MYSTERY TYPE IN PROCESS OF CONSTRUCTION—FIG. 3—THE WAR MYSTERY COMPLETED AND READY FOR LAUNCHING—FIG. 4—DECK VIEW SHOWING THE LARGE CARGO HATCHES—FIG. 5—THE WAR MYSTERY JUST AFTER SHE WAS LAUNCHED

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when this country entered the war with Germany. The principal men in the organization are: A. A. Daugherty, structural contractor and engineer, formerly of California; P. J. Reilly, Philadelphia, president of the National Oil Co.; John F. Penrose, Philadelphia, an owner of oil properties in Mexico; G. Van Alstine, California, secretary of the company, and W. A. Ebsen, New York, ship designer and engineer.

Concerning the vessels being built at the National yards, Mr. Ebsen, the company engineer, said as follows:

"These ships, as we are equipping them, are not intended for speed, though they are designed along clean and graceful lines. They are, however, built for hard practical use, in the north Atlantic or any other sea."

Rare Woods Used in Shipbuilding

By C. D. Mell

TRUE West Indian mahogany (*Swietenia mahagoni*) is classified as one of the standard shipbuilding woods of the world. In the English, French and Spanish markets its reputation for this purpose was very high in the early part of the eighteenth century. It is listed with Lloyd's shipbuilding timbers and no surer practical classification exists than that of Lloyd's, as it is the result of long experience with woods with reference to their durability, strength and general wearing qualities. Before the more general introduction of iron for use in shipbuilding, mahogany was highly esteemed among naval architects and it was regarded as being superior to teak for practical purposes.

Builders of small boats in the American tropics have always used mahogany for planking, decking and, in fact, for all parts of boats with satisfactory results. In the early days, mahogany was used far more extensively in shipyards than it is now. The butts of old trees, as well as the parts of the trees where the large branches join with the massive trunks, formed knees for many large seagoing ships. Even the framework of many sailing vessels consisted entirely of mahogany. In one instance a condemned sailing vessel that was out of commission for many years was sold at auction in Liverpool to the highest bidder. The purchaser of the craft removed the large timbers and sold them to Liverpool furniture and cabinet makers at such fancy prices that he cleared enough money to set up in the timber business, which later developed into a large and reputable enterprise.

Much Mahogany Used Today

The use of mahogany for boatbuilding has never been discontinued. According to the London *Times* for March 19, 1863, the main and lower decks of the armor-plated frigate OCEAN were constructed of mahogany, teak and greenheart. The Carnegie institution, Washington, built a boat at Miami, Fla., in 1907, that was constructed entirely of mahogany, which was obtained on the keys and hammocks of extreme southern Florida, where the best wood is produced. Although the use of mahogany in ship construction is now decreasing, this is due not because there are now other and better woods in use, but because certain other shipbuilding woods are less expensive, more easily accessible and more plentiful. Again, the equipment in tropical America for getting out long lengths is wanting. The large ships that are being built now require rudder posts, for instance, that are from 30 to 40 feet in length. While such lengths are in the forest, they cannot be removed so readily with the oxen which are the only means of transportation in Central America, where the trees are very widely scattered over vast areas, without roads.

The subject of mahogany in all its phases has been discussed in a good many trade and scientific journals and the layman is fairly well informed regarding the wood and its most common uses. It will suffice to state here that the weight of the wood, when freshly cut, is a little over 75 pounds per cubic foot, which is reduced to about 45 or 50 pounds when thoroughly seasoned. While the wood is strong and durable, it is easy to work, and when seasoned, it will float in water. It takes a beautiful polish and owing to its peculiar qualities, resists the influence of close contact with iron.

Facts About Woods

This is the first of a series of articles on rare and little-known woods used in shipbuilding. The author, who was formerly a United States forest examiner, is now connected with the firm of C. H. Pearson, New York, dealer in special woods. Mr. Mell has a thorough knowledge of the various woods used in shipbuilding and the articles he has prepared on the subject are timely and interesting. Mr. Mell's next article will appear in an early issue.

Book Review

Marine Engineers' Guide, by Theo. Lucas, Frank D. Graham and N. Hawkins; cloth; 866 pages, 4½ x 7 inches; published by Theo. Audel & Co. and furnished by THE MARINE REVIEW for $3.00 net.

A reliable handbook often proves of untold value to the chief engineer, the assistant engineer, the marine fireman, the machinist and the student, as it enables each one to find a ready answer to many complex questions on which authentic data are not always readily obtainable.

The material in this handbook is arranged under 19 general heads as follows: How to figure, elements of steam engineering, marine boilers, marine engines, propeller wheels, auxiliary machinery, pipes and piping, turbines, general care and management, refrigeration, breakdowns and repairs, oil burners, practical electricity, electric ship propulsion, gasoline engines, gas producers, diesel engines, United States regulations, and steam and steam tables.

The book contains 608 illustrations and is divided into 35 chapters. Much of the information is imparted by means of questions and answers. This arrangement makes each paragraph complete in itself.

The book is thoroughly up to date in all respects and the illustrations show modern types of engines, marine machinery and appliances. The book is well written in clear language and should prove a valuable addition to the libraries of those interested in marine engineering, from the fireman to the chief engineer.

F. J. McCrail, who for several years has been superintendent of the foundry operated by the Struthers-Wells Co., Warren, Pa., has resigned to become affiliated with the pattern lumber sales force of Smith, Fassett & Co., wholesale lumber merchants, North Tonawanda, N. Y.

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American Ship Yard Activities

A Snappy Summary of the Leading Events of the Month in the Vessel Construction Field

Henry Ford Enters Shipbuilding Field

THREE thousand men are rushing work on the Ford shipbuilding plant, at Detroit on the River Rouge. The fabrication shop—the first building of the big factory—is already under cover. Building operations have only been under way a little over a week. The Ford Motor Co. is under contract with the government to have the shipbuilding plant completed and producing "sub-chasers" not later than May 10.

Henry Ford's entrance into the shipbuilding world is the result of an appeal from the navy department. With the shipyards of the country taxed to capacity, the Ford Motor Co. was asked to aid the work by Secretary of the Navy Daniels. The Ford plant was found to be one of the few plants in the country with the necessary equipment and manufacturing organization to do the work.

The shipbuilding plant will cover an area of five acres, and will be made up of five structures—a fabricating shop, 150 x 450 feet; three bays or assembling plants, 100 x 1700 feet, and a fitup shop, 100 x 1500 feet. Buildings and equipment will cost approximately $3,000,000.

To Dredge Canal

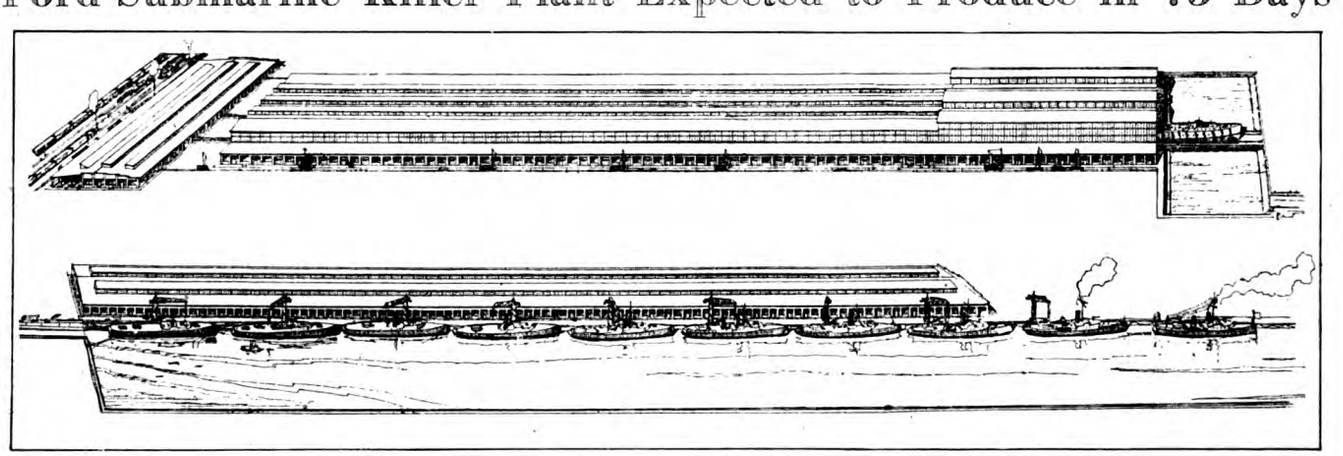
A canal from the River Rouge along the blast furnace property to the extreme north end, where the shipbuilding plant is being constructed, is being dredged and widened for navigation. The canal starts at the intersection of the River Rouge and Roulo creek. It will extend up the Roulo creek for a distance of 2614 feet. The present width of eight feet will be extended to 110 feet. Concrete walls, 10 feet deep will form the embankment. At the entrance of the canal will be a turning basin for lake freighters which will have an area of 989,100 feet.

The process of turning out the submarine killer will be similar to that employed in the Ford Motor Co.'s motor car plant. That is, the boats are to be kept moving from one operation to another—as the Ford automobiles are assembled by a conveyor system.

The steel for the hulls will be loaded in the fabricating shops, and here the first frames of the boat will be constructed. The skeleton will then be moved out on rails to the bays or assembling plants where it will be moved from one process to another until the hulls are finally put together. The completed hulls will then be moved on to a transfer table and carried to the slip. Here they will be raised by hydraulic lifts and dropped into the water.

This system will be employed so that the chasers can easily be brought back to drydock in case anything is wrong in floating. The boats will then be lined up at one end of the long fitup shop, and the first installation of the motor parts made. They will be gradually worked down the length of the

Ford Submarine Killer Plant Expected to Produce in 75 Days



THE drawing shows how Henry Ford's shipbuilding plant, now under construction at River Rouge, Detroit, will look when completed. The drawing is in two sections, the lower one connecting at the right of the upper. Materials for the building of submarine killers will go into the fabricating shop, shown at the left of the upper section, and as put together will be carried on rails into the bays adjoining. Here as a hull gradually is assembled it will move through the bay until, ready for launching, it reaches the transfer table, shown at the right of the upper section, and is dropped into the water. It then will pass through a slip to the position of the first boat shown at the dock in the lower view. Here equipment will be installed and the vessel moved to the position in which the second boat appears. It will be moved up in turn to the positions indicated by the succeeding boats, and will be fitted out in consecutive operations. At the last place, wireless will be installed and the boat will be ready for its trip to the submarine zone. Crews of the boats will be trained on the scene and will follow the construction of their craft through every stage, manning them when they are complete. The plant, which will cover five acres of land north of the blast furnaces, is expected to be completed and producing before May 10—75 days.

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fitup shop until the boilers and final machinery are put into place. The last operation will take in the placing of the wireless apparatus. The killer will then be ready for its trip to the submarine zone.

Crews for the boats will be trained at a naval station, just across the slip from the shipbuilding yards. They will follow the construction of their craft through every stage, manning them when they are complete. The training station will be similar to that at Great Lakes, Ill., but on a smaller scale. It is planned to build barracks for housing 2000 men. As the crews leave they will be replaced by new pupils.

Competent Men in Charge

Work at the plant will be under the direct supervision of navy department officials. They are Commander Carlos Bean, inspector of machinery; Ensign Henry Eisman, superintendent of construction; Charles C. West, member of the naval commission and an official of the Manitowoc Shipbuilding Co., and Lieut. H. A. Thayer, cost inspector.

A full size model of the submarine killer is now under construction at the Ford Motor Co.'s plant in Highland Park, Detroit. The keel of the boat has been laid, the steel ribs are in place and the plate work has been started. It is expected that by the time the plant is ready for operation the first chaser will be completed.

The boat is 200 feet long and 30 feet beam. She has a draft of 8 feet. Two cannons are mounted on her decks, and a time bomb device completes her armament. These bombs are rolled off her sides, and, according to navy officers, will work havoc with the submarines of the Germans.

South Builds Its First Steel Ship

THE first steel ship to be launched south of Newport News, Va., was sent sideways into Lake Borgne canal, Violet, La., 12 miles down the Mississippi river from New Orleans, on Feb. 14, from the yards of the Alabama & New Orleans Transportation Co. The vessel is the MEXOIL, a 16,000-barrel tank steamer, built for the Pan-American Petroleum & Transportation Co., Los Angeles, Cal. In Fig. 2 the MEXOIL is shown taking the water.

The vessel is of the Isherwood type, and while the steel was furnished by the Tennessee Coal, Iron & Railroad Co., all plates and beams were cut, bent and drilled in the Violet shops of the builders. The MEXOIL is 246 feet long, 36 feet beam, 19 feet depth and 14 feet draft. Her gross tonnage, according to David Hunter, who has had charge of the construction work since the keel was laid in March, 1917, is 3000, while her deadweight tonnage is 2300. Mr. Hunter is shown in Fig. 1, standing on the deck of the MEXOIL just before she was launched. He enjoys the distinction of being the builder of the South's first steel ship.

The company is now planning to build three sister ships to the MEXOIL. One of these, the PANOIL, is more than half completed, while the keel of another has been laid on the ways vacated by the MEXOIL. The price paid for the tankers, delivered in the Mississippi river at New Orleans, with boilers, engines, wireless and all other equipment installed, is placed by Mr. Hunter at $600,000 each.

Propelling Machinery

The propelling machinery of the MEXOIL and her sister ships consists of two Scotch boilers, 12 x 9 feet, equipped with oil-burning furnaces, which supply steam to one turbo-generator furnished by the Ridgeway Dynamo & Engine Co., Ridgeway, Pa. The turbine is direct-connected on the same shaft with the generator which supplies current to two 350-horsepower motors, each of which drives one of the twin screws. It is estimated that the MEXOIL will be able to maintain a speed of 10 knots an hour.

The boilers and the engine room are

FIG. 1—DAVID HUNTER—BUILDER OF THE SOUTH'S INITIAL STEEL SHIP

situated far aft and the space for more than three-fourths of the length of the hull is divided into four compartments, each capable of holding 4000 barrels of oil. Aft of the aftermost compartment, instead of the customary bulkhead, there is installed the fuel oil tank which has a capacity of 700 barrels.

Quarters for the officers and crew are in two deck houses built of steel. The officers' quarters are situated aft, while the quarters of the crew are forward. The wheel house and bridge are over the officers' quarters.

Working Under Difficulties

The second vessel to be built by the company will be launched about April 1, the third will follow about 10 weeks later. The fourth boat will take the place of the second on the ways as soon as the latter is launched. According to Mr. Hunter, who is in active personal charge of the work, the 11 months spent in building the first vessel was due to delays in receiving shipments of steel, the length of time required to install the shops at Violet and the time consumed in training green men, as it was found impossible to get experienced steel shipbuilders at any price. Mr. Hunter's force now consists, with the exception of a few foremen, almost entirely of men whom he has trained to their jobs. He estimates that he can average one steel tanker of the MEXOIL type every four months.

The successful launching of the MEXOIL should, and it no doubt will, have a marked bearing on the future of shipbuilding at New Orleans which has been hampered by the popular belief that vessels as large as the MEXOIL could not be launched successfully in shallow waters. The MEXOIL, however, was launched in a stream which is less than 18 feet deep and approximately 100 feet wide. As a matter of fact, a strip on this canal, from the shipyard to the Mississippi river, was dredged from about 15 feet to 18 feet, especially for handling the MEXOIL.

The Mississippi river is about 300 yards from the place of construction of the ship, the canal ending in a lock. Owing to the fact that the MEXOIL had to go through this lock, she was constructed 5 feet shorter than the concrete chamber. Thus, taking her out to the river was an exacting bit of work. The boilers and turbo-generator were installed while the hull lay in the

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canal and as the boilers weighed 20 tons each and the turbo-generator 16 tons, considerable skill had to be exercised as the handling equipment was of light construction.

The MEXOIL was not built on regular ways, but on skids. These dipped at a sharp angle from the keel into the canal. On these skids the hull was shored up as the plates rose on the frames. Then the bow and the stern was made fast to the shore by means of heavy cables. The shoring was knocked away a few moments before launching and the cables cut. Then the vessel slipped easily into the water.

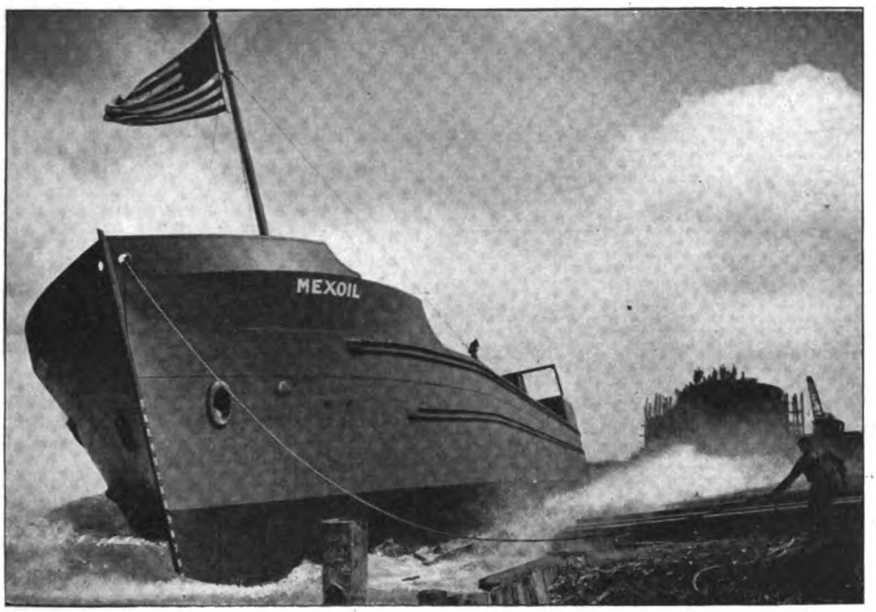

FIG. 2—THE MEXOIL TAKING THE WATER AT LAKE BORGNE CANAL NEAR NEW ORLEANS

Marine Machinery

Marine machinery, pneumatic hoists, steam and air motors and contractor's equipment are described in a 64-page catalog recently issued by the Dake Engine Co., Grand Haven, Mich. The catalog is well illustrated and contains descriptions of each article, including air engines, boilers, blowers, capstans, centrifugal pumps, hoists of various kinds, steering gears, winches, fans, etc.

The company's square-piston engine, which operates either by air or steam, is described fully and several illustrations are included to show its adaptability for various purposes. This engine has two square pistons, one operating within the other.

It is said that these engines operate with equal efficiency in any position; vertical, horizontal or at an angle. It is also claimed that they give satisfaction in isolated service as they can be operated by ordinary laborers. It is pointed out that these engines have no dead centers and that they can be started, stopped and reversed instantly.

Will Build 36 Vessels at Savannah

The French government has awarded the Foundation Co., New York, a contract for constructing 36 mine sweepers. To handle this contract, the company recently started the erection of a yard at Savannah, Ga. According to specifications, the sweepers will be 150 feet over all, 25-foot beam. They will be capable of making 11 knots with a 2000-mile radius of action. Triple-expansion engines will be installed. The company expects to have the vessels ready for delivery by Jan. 15, 1919. This is the second contract received by the Foundation Co. from the French government. The first one called for the construction of 40 five-mast auxiliary schooners of 3000 tons deadweight capacity. The work was allotted to the company's yards along the Pacific coast. The Foundation Co., through its subsidiary, the Foundation Co, Ltd., of British Columbia, also received a contract from the British government, some time ago, for building wooden cargo steamers of 2800 tons deadweight capacity.

The Savannah yard is the fifth to be established by the Foundation Co. since April, 1917. The other plants are located at Newark, N. J., Portland, Oreg., Tacoma, Wash., and Victoria, B. C. The yard at Savannah occupies 550 acres, and has a waterfront of 3000 feet and a depth of 1800 feet. The yard will have nine ways. The company plans to construct simultaneously two sweepers on each way. This gives the yard a capacity of 18 vessels. According to the operating schedule, the first three ships will be launched on July 15 and will be ready to put to sea two months later.

Galveston to Have New Drydock

By the terms of a contract which was recently awarded for the construction of a 10,000-ton floating drydock on Pelican island, adjacent to Galveston, Tex., the United States government will advance to the Galveston Dry Dock & Construction Co. 80 per cent of the cost of the plant, exclusive of the site, dredging and the building of the necessary machine and repair shops. The drydock will cost approximately $850,000, and the government, it is said, will advance about $600,000.

In the contract, it is provided that the drydock shall be completed within seven months. The loan of $600,000 by the government is on terms that are intended to enable the drydock company to purchase the drydock at a substantial discount within four and one-half years after peace has been declared. The discount is allowed on account of prevailing abnormal conditions.

Estimating the difference between the cost now and what the cost would have been before the beginning of the European war, officials of the Emergency Fleet corporation have agreed to allow a discount of 33 1/3 per cent on the amount advanced if the war ends within one year after the dock is completed. The amount of the discount increases as the duration of the war increases, three years being the maximum. If the war ends in two years a discount of 38 1/3 per cent will be allowed and if in three years the discount will be 43 1/3 per cent. In other words, if peace is declared during the first year, the government having advanced $600,000, the principal to be returned will be $400,000. If hostilities continue longer, the amount to be paid back will decrease by 5 per cent each year up to three years.

All work done for the government will be credited to the dock company's account. If a sufficient number of ships are docked and repaired for the government to aggregate $100,000 during one year of war, this amount would be deducted from the principal, leaving only $300,000 to be refunded. It is possible that the government may utilize the dock and repair facilities of the plant to the extent that all of the principal would be paid before the expiration of the four and a half years after peace is declared.

The dock was designed by William T. Donnelly, New York. Plans call for a dock of 10,000 tons, built in two sections, one of 6000 tons and one of 4000 tons. The two sections are to be bolted together to form a dock of 10,000 tons.

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Operated in two sections, two vessels can be docked and repaired at the same time. It is estimated that 90 per cent of the ships requiring facilities can be handled on the 6000-ton section and in that way, operating costs can be reduced as compared with the cost of operating a single dock of 10,000 tons.

The contract provides for a dock of wooden pontoons and steel wings. The pontoons are so constructed that a section may be removed and repaired without loss of time. The wooden pontoons will be effectively protected from the ravages of the teredo, a precaution especially necessary in semitropical waters. The structure will be 600 feet long and 110 feet wide.

Latest News from American Shipyards

The Downey Shipbuilding Corp., New York, has laid keels for three vessels and during the month of May it will launch the first of a group of 10 standardized ships which it is building for the Emergency Fleet corporation.

* * *

The Coastwise Shipbuilding Co., Baltimore, is building 10 barges for the Philadelphia & Reading Transportation Co., Philadelphia. The barges are of 1600 tons carrying capacity, 210 feet long, 35 feet beam, and 19 feet depth of hold. The barges will ply between Philadelphia and New England coastwise cities.

* * *

The Eastern Shore Shipbuilding Co., Sharptown, Md., has under construction a 4-mast schooner of 2500 tons carrying capacity. All the material for the vessel is on hand and work is being rushed with the expectation of having the schooner ready for launching by the middle of summer.

* * *

James Shewan & Sons have bought the Raritan Drydock Co.'s property, Perth Amboy, N. J. It has a frontage of 750 feet along Staten Island sound and is equipped with three drydocks of 500, 2000 and 4500 tons capacity.

* * *

The McAteer Shipbuilding Co., Duwamish Waterway, Wash., recently laid the keels for two 2500-ton auxiliary-powered schooners. These vessels were ordered by private interests. The ways are ready for operation and more than 500,000 feet of shipbuilding lumber has been assembled. The plant is also handling a large amount of overhaul and repair work.

* * *

On her recent trial trip, the WESTFIELD, an 8800-ton steel steamship, built by J. F. Duthie & Co., Seattle, averaged 13.2 knots per hour, nearly three knots in excess of the contract speed. The trial trip was made in Puget sound and when the vessel returned to Seattle she was immediately accepted by the United States shipping board.

* * *

The steel steamer MARINERS HARBOR was launched recently at the plant of the Staten Island Shipbuilding Co., New York. The vessel is the third launched of 10 that the company is building. The MARINERS HARBOR is 270 feet long, and registers 3500 tons. She is equipped with 1400-horsepower engines, which give her a speed of 10½ knots an hour.

* * *

The Olympia Shipbuilding Co., Olympia, Wash., recently launched a 5-mast auxiliary schooner, the last of three of the same type. The vessel is 295 feet long, with a net tonnage of 4000. Her ownership is represented by W. C. Bristow, Portland, Oreg., as agent for the Korsnaes Navigation Co.

* * *

The Ericksen Engineering Co., Seattle, expects to have its new steel ship plant completed in a short time. Several of the big buildings are completed and the work of installing machinery is in progress.

* * *

The National Concrete Boat Co., it is announced, will erect a yard at Norfolk, Va. Concrete barges from 700 to 1000 tons capacity will be built.

* * *

Six hours after delivering the commandeered 8800-ton steel steamer, WEST ARROW, to the United States government, the Skinner & Eddy Corp., Seattle, on Feb. 26, launched another 8800-ton ship, the CANOGA.

* * *

The Pearson Syndicate, headed by Lord Cowdray, the first corporation to develop the oil fields at Tampico, Mexico, has purchased waterfront property in Mobile, Ala. It is reliably reported that a refinery and a repair plant for oil tank steamers will be erected on this property. The company also has entered Washington and Clark counties, Alabama, prospecting for oil, and has taken leases on 80,000 acres of land in those counties. Mobile reports place the investment to be made by the Pearson Syndicate in that port at $3,000,000.

* * *

The United States Steel Corp. is building a shipyard at Chickasabogue, Ala., eight miles north of Mobile. Early in December this concern bought 1160 lots adjoining its land, which increased its total holdings there to 12,396 acres. Five hundred men are at work clearing the land, building the ways for the steel ships to be constructed and erecting 2400 houses for employes.

* * *

All the shipyards along the gulf coast are being combed by agents of the government in their search for alien enemies. Eleven have been picked up around the shipyards and along the canals in New Orleans, six in Mobile, five in Galveston, and several at Biloxi, Gulfport, Pass Christian, Pascagoula and other points along the sound. Federal officials have warned shipyard operators to exercise extreme care in employing men.

* * *

The steamer LAKE CLEAR, building for the Emergency Fleet corporation, was launched recently at the South Chicago yard of the American Shipbuilding Co. The ceremony took place at 10 a. m., and at 3 p. m. of the same day the keel for another government vessel was laid on the same berth. The LAKE CLEAR is full Welland canal size, and will be completed by the time navigation opens, when she will leave for the coast. She was originally built as the WAR LAUREL.

* * *

The Universal Shipbuilding Co., Sturgeon Bay, Wis., has perfected its organization by the election of the following officers: President, Philip Brinzel; vice president, Gustav A. Huck; second vice president, Hubert Riesen; secretary, Louis Liebscher Jr.; treasurer, Herbert L. Peterson; directors, Max Grefig, Walter F. Pommer, Ignatz Wetzel and Theodore C. Froemming. The Riebolt & Wolter yard has passed into the ownership of the new company, but the present owner will complete the government transport now on the stocks. This vessel will be launched about May 1, after which the new owners will start to make extensive improvements. These are to include the addition of several new shops and larger berths.

* * *

The Martinolich Shipbuilding Co., located at Quartermaster Harbor, between Seattle and Tacoma, has contracts for building four and possibly six wooden vessels for Norwegian interests.

* * *

The Three Rivers Shipyard Co., Ltd., has been organized by Thomas M. Kirkwood, Toronto, for the construction of wooden ships at Three Rivers, Que. The cost of each vessel will be $450,000. A 5-acre site has been acquired on the western side of Three Rivers harbor. The plant will consist of one two-story machine and pattern shop, 75 x 175 feet, and two 250-foot slips on pile foundations.

* * *

The Beaumont Shipbuilding & Dry Dock Co., Beaumont, Tex., has been awarded two contracts by the Emergency Fleet corporation, involving an expenditure of approximately $10,000,000. One of the contracts is for equipping 30 wooden ships and the other for the construction of a large floating drydock at Beaumont. In connection with the building plant there will be constructed machine shops, warehouses, storage lofts and a 1500-foot wharf. The contract for equipping the 30 wooden ships covers mostly the labor, the government undertaking to furnish the machinery and equipment. The drydock will have a lifting capacity of 8000 tons. It will be sectional in design in order to enable its enlargement from time to time. The plans call for an ultimate capacity of 14,000 tons. The drydock will be used both by the government and by private shipping interests. J. W. Link is president of the company.

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On the Coasts, Lakes and Rivers

What's Doing and Who's Doing It

Rush Preparations For Early Opening

By M. H. Kinkead

AFTER one of the most severe winters in the history of the Great Lakes, the outlook for an early opening of navigation is favorable. Reports indicate that Lake Superior is still impenetrable for 30 miles east of Duluth with heavy ice at the Soo, but the ice in the western portion of Lake Erie is breaking up rapidly, although the formation between Ashtabula and Buffalo is hardly disturbed. The western part of Lake Ontario shows considerable open water, with extensive ice fields toward the eastern end. Weather conditions point to an early breaking up, however, and a number of fleet owners, among them G. A. Tomlinson & Co., have ordered their engineers to report, so that the ships will be ready to start as soon as a channel can be made.

A number of grain carriers which were damaged by the ice in their attempts to bring down cargoes after the season had closed last December, are now undergoing repairs, and refitting is going on energetically at every port on the lakes.

This season, many ships will be operated under the plan to pool all traffic on the Great Lakes. This plan has been adopted to effect the transportation of a maximum tonnage with a minimum loss of time in loading and unloading. Under this system of centralized control the vessels will be dispatched so as to avoid delays at any port and to satisfy equitably the demands of the various trades. If present indications for an early opening are borne out, the end of the 1918 season should show a record tonnage of freight traffic. The pooling of cargoes will help to offset the shortage of carriers which has been brought about by the government's plan of commandeering lake freighters for salt-water service.

* * *

The steamer HARRY YATES, of the American Steamship Co., Boland & Cornelius, Buffalo, managers, is in drydock at Toledo for repairs to several of her plates. The YATES ran aground at Vidal shoal last October.

* * *

The Trotter Wrecking Co., Amherstburg, Ont., will start shortly on the work of floating the Southeast Shoal lightship FALKEN, sunk at Scudders dock, Pelee island. The FALKEN will be taken to Detroit for repairs as soon as she is raised, as she is reported to be considerably damaged.

* * *

Walter M. Williams, Cleveland, has been appointed agent of the division of operation of the Emergency Fleet corporation, and will have charge of moving to the coast all ships constructed for the government, in the ninth district, comprising the Great Lakes. Mr. Williams is a vessel broker who has handled bulk freighters for a number of years and his wide experience fits him for this responsible work.

* * *

The million-dollar tank steamer, building for the Standard Oil Co. at the Lorain yard of the American Shipbuilding Co., was launched March 13. The steamer was christened WILLIAM P. GOWAN, after an official of the Standard Oil Co.

* * *

Capt. A. W. Holmes, master of the steamer CORVUS, of the Interlake Steamship Co., Cleveland, died suddenly Feb. 7 aboard the steamer H. G. DALTON, of the same fleet, at Port McNicoll, Ont. Captain Holmes was 56 years old, and had been master of the CORVUS for five years.

* * *

The crew of the steamer GRAND ISLAND, of the Cleveland-Cliffs Iron Co. fleet, won the $50 prize offered by a Cleveland banking house for the largest bank deposits made between May 1 and Dec. 1, 1917. The GRAND ISLAND'S total was $11,000. The steamer JOHN STANTON, of the Hutchinson & Co. fleet, Cleveland, also won a $50 prize for having the largest bank balance at the close of the navigation season. This sum was $7000. In this contest the GRAND ISLAND finished second and the steamer MUNISING third.

* * *

Reports from Halifax, N. S., state that the steamer SARANAC, formerly operated on the Great Lakes by the Lehigh Valley Transportation Co., Buffalo, has been salvaged by Capt. J. T. Reid. The SARANAC, which was sent to the coast last season, was beached in Halifax harbor during the explosion last December.

* * *

The Duluth, Missabe & Northern railroad has nearly completed its new ore dock at Duluth, which will cost $2,500,000 when finished. It is believed that the dock will be ready for operation when navigation opens. The company is also rebuilding the approaches to its docks No. 3 and 4.

* * *

The steamers GEORGE A. FLAGG and R. S. WARNER of the M. A. Hanna & Co. fleet, Cleveland, have been commandeered by the United States shipping board for salt-water service. The steamers, which have been laid up at Ashtabula for the winter, will be brought to Cleveland for reconstruction. They were built by the American Shipbuilding Co. in 1901 and are duplicates, of 4300 tons capacity. They are 318 feet long and 42 feet beam. They will be in shape, it is expected, to leave for the coast by May 15. This transfer to the government will mean a readjustment in the plans of the fleet, as the FLAGG and the WARNER have towed the barges A. W. THOMPSON and S. D. WARRINER since they were built.

* * *

The steamers P. P. MILLER, J. S. ASHLEY and CALDERA were caught in a storm in the outer harbor at Cleveland recently, and suffered several damaged plates from collisions. The CALDERA also hit a dock last season and is now in drydock, while she is having 12 plates replaced. She belongs to the Kinney Steamship Co., Cleveland, and is commanded by Capt. M. G. McIntosh.

* * *

Captain Van Buskirk and crew of the carferry MARQUETTE & BESSEMER No. 2 have gone to Erie, Pa., where they will take out the ferry, which has been in drydock at Erie during the winter, undergoing repairs to her hull and boilers. The ferry will be put in service between Rondeau and Conneaut harbor as soon as the ice moves out enough to make navigation practicable.

* * *

The steamers MARUBA, of the Hutchinson fleet, and YUMA, of the Richardson fleet, have been commandeered by the United States shipping board and will be fitted for salt water at once. It is expected that they will be ready about May 15 for transfer to the coast. The YUMA was built at Cleveland in 1893, and carries 2194 tons. She is 323 feet long and 42 feet beam. The MARUBA, built at Cleveland in 1890, is 291 feet long and 40 feet beam, and has a capacity of 2311 tons.

* * *

Steamer No. 471, building for the Emergency Fleet corporation, was launched recently at the Cleveland yard of the American Shipbuilding Co. She will be ready to leave for the coast as soon as the navigation season opens.

* * *

Early in March the ice on the Great Lakes was exceptionally thick, according to a report of the United States weather bureau and of the meteorological service of Canada. In western Lake Superior the ice extended solid east from Duluth for over 30 miles with some open water east of Grand Marais, Minn. There were 29 inches of solid ice the full length of St.

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Marys river and in Green bay the ice was heavy. Extensive ice fields were reported in northern and eastern Lake Michigan. In the Straits of Mackinac the ice averaged 30 inches, smooth, and not windrowed. The ice was heavy in central and northern Lake Huron. An extensive ice field covered eastern Lake Erie, but the ice was not reported heavy in Lake Ontario.

* * *

The small steamer COLUMBUS will be commissioned as soon as navigation opens to operate between Sandusky, O., and Ohlemacher's dock, across Sandusky bay. She will tow an automobile ferry. In order to conserve fuel, the G. A. Boeckling Co. will operate only one steamer, the G. A. BOECKLING, between Sandusky and Cedar Point.

Activities Along the Pacific Coast

TACOMA will soon celebrate the launching of the first steel steamship constructed in that port. The occasion will be the first contribution of the Todd Drydock & Construction Corp. to the merchant marine of the United States. The yard is making rapid progress on four steel hulls of cargo ships each of 7500 tons deadweight. These vessels are built on the Isherwood system, the first of that type built by this company or its allied yard, the Seattle Construction & Drydock Co. The Todd plant has been built on Tacoma's tideflats in an admirable location during the last eight or nine months, and the launching of the first steel cargo vessel from a Tacoma yard will be the occasion of a big celebration as it marks the entry of Tacoma into the circle of great shipbuilding centers.

* * *

Material increases in freight rates between Seattle and Alaska have lately become effective, according to an announcement made by the various lines engaged in Alaskan trade. Freights to the north have not kept pace with increases in other routes, but advancing costs of operation have made higher rates imperative. The new tariff increases the rate on canned salmon from southeastern Alaskan ports to Seattle from $3.75 to $5 and from ports in southwestern Alaska the advance is from $4 to $5.50 per ton. Box shooks, tin plate and tin cans to all Alaskan ports will advance $1 per ton, while on hay, grain, flour and similar merchandise the increase is 50 cents per ton.

* * *

The Emergency Fleet corporation has leased half of the Hanford street terminal of the port of Seattle and there it is assembling the equipment for a large number of wooden ships being completed in this district. In the state of Washington alone, 50 wooden ships are under construction for the government, and from the Seattle headquarters they will be fitted out. J. E. Pharo, a widely known shipping man, has been appointed general district storekeeper, and under his direction the equipment is being assembled.

* * *

Never before in the history of Puget sound have the drydocks and repair yards had such a busy winter as the past. Practically every dock has been in constant use and in some instances vessels have had to wait their turn. The new floating dock of the Todd Drydock & Construction Corp., Tacoma, has been in constant use since its completion several months ago. The Seattle Construction & Drydock Co. has also had its docks continually occupied. The latter plant has recently completed extensive repair work and alterations on the steamship ADMIRAL WAINWRIGHT, preparatory to turning this vessel over to the shipping board. The steamship RAVALLI, of the Pacific Steamship Co., has also been repaired at this yard, after having been disabled in Alaska. The same company is approaching completion of its immense contract for rebuilding the steamship CONGRESS, since renamed NANKING. The CONGRESS was burned at sea and has practically been rebuilt. This is the largest repair job ever awarded on this coast. The NANKING is expected to be turned over to her new owners, the Pacific Mail Co., in about a month.

* * *

Unable to obtain a vessel from the navy, the board of commissioners of the Washington State Nautical school have determined to erect suitable barracks ashore and bids for this structure will be opened next month. The building will be as far as possible a replica of a ship so that young men may get practical training in navigation. The board is composed of the following representative shipping men: Capt. J. S. Gibson, retired shipmaster and president of the International Stevedore Co.; Frank Waterhouse, president of Frank Waterhouse & Co., ship agents and operators, and J. D. Trenholme, a ship broker and charterer.

* * *

In addition to general overhauling of a number of lumber vessels, the yards of the Winslow Marine Railway & Shipbuilding Co., Winslow, have about completed extensive repairs to the old whaling ship BELVEDERE. This vessel was formerly equipped with steam auxiliary power and was square-rigged. She has had gas engines installed and has been rerigged as a schooner. The BELVEDERE has cruised in the Arctic for many years, and with the improvements it is expected she will be much more serviceable for this trade.

* * *

Everett, Wash., has just celebrated its entry into the circle of Puget sound terminal ports with the arrival of the Japanese steamship KINKASAN MARU from Darien. This vessel was diverted to Everett because of the congestion at the oil terminals in Seattle. Everett is also planning on the installation of a large steel shipbuilding plant, plans for which are already well under way. Norwegian capital is interested in this proposed yard.

* * *

Whaling interests of the north Pacific have been consolidated by the merging of the North Pacific Sea Products Co., the Victoria Whaling Co. and the American-Pacific Whaling Co. The first-named company operates at Akutan, near Unimak pass, the Victoria company on the west side of Vancouver island, and the American-Pacific company on Grays Harbor. The various units of the combination will operate as heretofore but will specialize in canning whale meat. The new company will have six large land stations and 17 whaling vessels.

* * *

That importing companies expect the diversion of Oriental oils from the Suez canal route, due to war conditions, to the Seattle gateway, will continue after the war, is indicated by the construction of permanent steel oil terminals in Seattle. Two large storage terminals have been opened there this month. Seattle now has 27 large tanks with a capacity exceeding 4,600,000 gallons and additional units are planned. The oil trade is new to Seattle, as before the war this trade was routed to the Atlantic coast via Suez. The importing companies have found conditions favorable here and they predict that Seattle will continue as the port of entry for much oriental freight that formerly was shipped through the Mediterranean.

* * *

Vancouver, B. C., is nursing a healthy shipbuilding infant. In the British Columbia city 5000 men are now employed in the shipyards. The yards at Vancouver and points close by have contracts for 104 steel and wooden ships.

* * *

The Ames Shipbuilding & Drydock Co., Seattle, recently launched an 8800-ton steel steamship which was christened the WEST EAGLE. This is the second vessel the company has launched within a month. The first ship is the WEST WOOD, another 8800-ton vessel. The Ames company is a comparatively new concern and it is said that no other shipbuilding firm has equaled the company's record of launching two vessels in the first year. However this may be, the record is one of which the company can be justly proud and it proves conclusively that American shipbuilders are on the job day and night.

* * *

On her official trial trip lately, the auxiliary-powered schooner YPRES logged an average of 7.3 knots an hour, notwithstanding that a high wind was blowing. The vessel is a product of the Puget Sound Bridge & Dredging Co., constructor for the Washington Shipping Corp., Seattle. It is reported that the vessel's twin engines worked satisfactorily and that the ship handled easily. The YPRES is 250 feet long, 43 feet 6 inches beam and 21 feet deep. She has received the highest rating in the Bureau Veritas, France.

* * *

The United States shipping board has awarded the Skinner & Eddy corpora-

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tion, Seattle, a contract for 14 8800-ton steel cargo ships. It is said that this is the largest order yet placed for ships on the Pacific coast. While no details as to price have been given out it is understood in Washington, D. C., that the total for the 14 ships exceeds $20,000,000. This order makes a total of 20 contracts awarded to the Skinner & Eddy corporation since early last summer.

* * *

Nineteen wooden ships, each over 2500 tons deadweight, have been launched on Grays Harbor, Wash., since the shipbuilding industry was revived two years ago. With 13 ships under construction shipbuilding in this district is now at its height. During the present year as many more vessels will be launched. It is expected that a vessel will be launched every three weeks.

* * *

Two big wooden ships, the five-masted topmast auxiliary power schooner KORSNOES and the freighter CETHANO, were launched in Olympia, Wash., recently. The KORSNOES slipped down the ways at 5 o'clock in the morning at the Ward yards and the CETHANO took the water at 4 o'clock in the afternoon from slip No. 1 at the Sloan yards. The CETHANO was the first ship to be launched by the Sloan yard. The KORSNOES will take a cargo of lumber for a Norwegian firm, probably to Australia, while the CETHANO is an Australian government ship. Superintendent Andrew Peterson, at the Sloan yard, announced that he expected to launch the second Sloan ship within about two weeks.

Along the Atlantic and Gulf Coasts

OPERATION of a Boston-Glasgow service will be undertaken by the Warren line, it is announced. The Allan line, after 25 years of business between Scotland and Boston, is to discontinue about May 1, many of the steamers having been requisitioned by the British admiralty. Allan line ships will, however, ply between Glasgow, Montreal and Portland, Me.

* * *

Tremendous profits are being taken by vessels employed in the Boston fishing industry. An illustration is the new schooner ACUSHLA, Capt. Ernest Parsons, which in nine months stocked $90,000 and each of the crew shared $2800. For a trip of four days' duration the ACUSHLA stocked $7000, the crew receiving $250 apiece. Other schooners are making large sums and fishing crews were never more prosperous.

* * *

The Boston Marine society has 88 beneficiaries and at the last quarterly meeting appropriated $4905 for their aid.

* * *

Steamer LEXINGTON, formerly CITY OF MACON, has been sold to the Northern Transportation Co. by the Merchants & Miners Transportation Co., and will be converted into a coal carrier.

* * *

Movement of West Indian raw sugar to Boston is about normal, the carrying being done principally in foreign bottoms. As many as four ships arrived in one week with consignments averaging 5,000,000 pounds. A few cargoes in bond have been reshipped to Montreal.

* * *

The Eastern Steamship Lines, Inc., is contemplating placing the steamers BELFAST and CAMDEN on the Boston-New York all-water service and the CITY OF ROCKLAND and CITY OF BANGOR are to maintain the service between Boston and Bangor. Steamers MASSACHUSETTS and BUNKER HILL, formerly on the New York route, have been taken over by the government.

* * *

The Cunard line has appointed Julius Rottenberg, Inc., Boston, general passenger agent in New England for the New York-Mediterranean service.

* * *

The Rangeley Hansen Shipbuilding Co., Brooklyn, N. Y., has lately been incorporated and it is announced that it will start business with a force of 200 employes. Samuel J. Flash, New York, attorney for the company, states that the plant will be located at Bay Thirty-fifth street and Cropsey avenue. The shipbuilding plant of Capt. A. Hansen, the Danish shipbuilder, whose plant was absorbed by the new company, is at this location. The new company has a contract with the government for small boats.

* * *

Two thousand dollars were shared by eight sailors of the new schooner THEOLINE for a 5 month voyage. This new vessel is commanded by Capt. L. C. Fickett, Portland, Me.

* * *

The Clyde line has appealed to the interstate commerce commission for permission to increase its rate on upland cotton and cotton linters from Jacksonville and Charleston to Boston and New York.

* * *

Steel barge BENMORE, of English build, has been bought by New York interests and will be rerigged as a ship.

* * *

Mexican interests have bought through New York parties the 2-mast schooner SCOTIA QUEEN, vessel to have auxiliary power installed and be used for transporting cattle between Mexican ports.

* * *

Capt. A. W. V. Trant, master of the torpedoed British steamship DEVONIAN, which plied in the Boston-Liverpool service, is named as superintendent of the convoy section of the naval staff.

* * *

The disappearance of the AURORA, now finally given up as lost, removes from the British shipping register a vessel which has played a prominent part in polar exploration. Built at Dundee in 1876, she was dispatched to the relief of the Greeley arctic expedition. In recent years the AURORA has figured in the Mawson and Shackleton antarctic expeditions. She reached Cape Evans on Jan. 10, 1917, in time to rescue the seven survivors of the Ross sea party. The vessel was sold to Grace Bros. & Co., Ltd., of London, in March last, and afterwards was transferred to her present owners, the New York & Pacific Steamship Co. She loaded a coal cargo at Newcastle, N. S. W., and sailed for Iquique, but was compelled to put into Sydney in a leaking condition. She resumed her voyage on June 20, 1917, since which date nothing has been heard of her.

* * *

The Union Ship & Dock Co., in conjunction with the firm of O'Conners & Bennett, consulting engineers, New York, is reported to have taken over property near Point Jefferson, L. I. The company has contracted to build eight large coal barges for the navy department. The barges will be 110 feet long, 32 feet beam and 8 feet deep and will have a capacity of 350,000 to 500,000 tons each. The barges are to cost $125,000 each.

* * *

Steam yacht INCA has been purchased by Lufkin & Tarr, Gloucester, Mass., and will be placed in the fishing industry.

* * *

More ships are to be allotted to the New Orleans-European trade, according to advices from Washington to shipping men in the Crescent City. Arrangements are said to be pending between the shipping board and the British admiralty. Great Britain so far has favored Atlantic ports, but loss of time from freight congestion on the eastern seaboard frequently makes up for the extra five days' steaming time each way to Europe from New Orleans.

* * *

The 1500-ton auxiliary schooner which is being built under Lloyd's supervision by the Mississippi Shipbuilding Corp. at the company's yards at Biloxi, Miss., was sold recently through F. L. Zimmerman to a Boston concern. The vesesl will be delivered to her new owners in March, who will send her to Australia.

* * *

M. M. Davis & Son, Inc., New York, have completed and launched at their Solomons, Md., yards a 1700-ton coal barge for the Northern Transportation Co. A tug, which is being built for the Bethlehem Steel Corp., was launched in January. This tug is 133 feet long and will be equipped with a 1000-horsepower engine. The Davis shipyard makes a specialty of tugs and barges.

* * *

The Coast Ship Co. has been organized with $100,000 capital at Biloxi, Miss., and will commence construction soon on six 2000-ton auxiliary schooners. D. J. Gay, Biloxi, is president. W. A. McInnis, Orange, Texas, is general manager and will be in charge of the yard.

* * *

More than 900 men are now employed in the shipyards at Pascagoula, Miss., and rapid progress is being made in the construction of ships. The Diercks-Blodget Co., a late comer in the field, has four keels laid, while plans for construction of four combination steamers are going forward. The building program of the company calls for 12 wooden ships of 3600 tons and four combination vessels of 8000 tons each.

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Equipment Used Afloat and Ashore

Cooler for Marine Turbine Oil—Heavy Duty Marine Engine—Treenail Machine

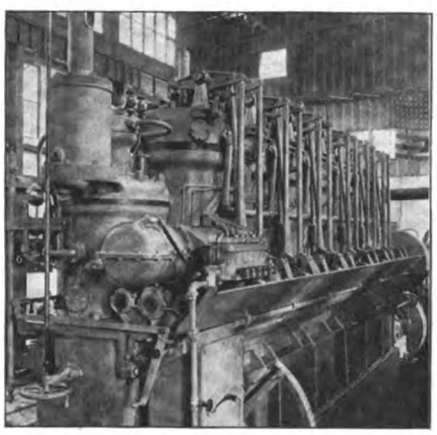
THE development of new and improved mechanical devices generally introduces minor problems that must be overcome before the greatest degree of success can be assured. Thus the improvements in marine engine design drew closer attention to the question of cooling the lubricating oil. With turbine engines, which are operated at comparatively high speeds, the subject of efficient lubrication is of vital importance. The proper cooling of the oil results in the maintenance of an efficient low temperature for lubrication and permits the continued use of a given quantity of oil. This is particularly desirable in connection with large marine turbine engines.

Variables Determine Area

The general subject of oil cooling is quite complex since the variables encountered, which determine the required area of the transfer surface for any given form of cooler, depend not only on the character of the oil, the inlet and outlet temperatures of the oil, the inlet temperature of the water and the quantity ratio of water and oil, but also materially on the temperature level, or the portion of the temperature viscosity curve through which the cooling is to take place. The viscosity of the oil plays an important part since the required transfer surface varies with it.

The engineering and designing staffs of the Griscom-Russell Co., New York, after considerable experimentation, developed the cooler shown in the accompanying illustrations. Following this development, an elaborate series of tests were conducted to determine the proper ratings, pressure losses, etc., for the various sizes and for different oils under various combinations of the above mentioned variables.

In the accompanying illustration, Fig. 2 shows the cooler assembled. The shell and the water head are cast iron, while the floating head is made of composition. Fig. 3 shows the entire tube bundle and baffle removed from the shell. The tubes are small diameter, seamless drawn copper tubing



CAMSHAFT SIDE OF DIESEL ENGINE

expanded into steel tube plates. One of these plates is of the floating head construction which allows for the expansion and contraction of the tubes without strain or expanded joints.

Fig. 1 shows the helical baffle with the spacer rods in place. The baffle is sheet iron or brass and the spacer rods iron pipe. An outside packed head construction is used. This removes all tube joints from the oil space and eliminates any possible leakage of the water into the oil. The cooling water passes through the tubes which are arranged in two passes. The oil is circulated through the shell and it is brought into contact with the cooling surface by means of the helical baffle.

The construction of the baffle is designed to insure a long smooth oil path with a minimum pressure drop. The low pressure drop is due to the fact that the helical form of baffle directs the oil in its flow without impeding its passage to any great extent. The entire tube bundle is removable for inspection without breaking the oil connections. The whirling motion of the oil passing through the shell tends to keep the surfaces clean, but should it become necessary to clean the cooler, this can be done readily by withdrawing the tube bundle from the shell.

Heavy Duty Marine Engine

There are now being shipped to the Pacific coast a number of 500-horsepower heavy-duty marine diesel engines, built by the McIntosh & Seymour Corp., Auburn, N. Y. The engine shown in the accompanying illustration has six cylinders, of the 4-cycle type, is single acting and directly reversible. The general arrangement and the valve mechanism may be noted.

The air for atomizing the fuel for the working cylinders, as well as that required for maneuvering is furnished by a three-stage compressor located at the forward end of the engine. In cases where the engines are used for twin-screw vessels this compressor is of sufficient size to supply atomizing and maneuvering air for both engines in case of necessity.

The fuel consumption of these engines is given as a trifle over 0.4 gallon of fuel oil per brake horsepower,

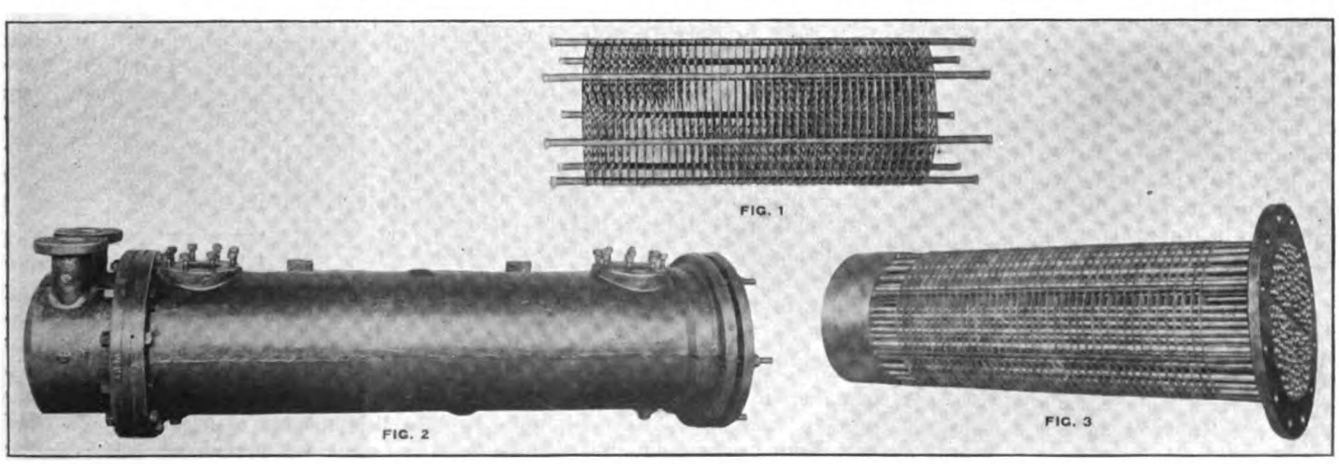


FIG. 1—HELICAL BAFFLE WITH SPACER RODS REMOVED FIG. 2—THE COOLER ASSEMBLED FIG. 3—TUBE BUNDLE AND BAFFLE REMOVED FROM THE SHELL

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when operated at rated speed and rated load. It has been demonstrated that the engines are capable of a reduction in speed of 60 per cent. The standard sizes built are 300, 500, 750, and 1350 brake horsepower.

Hoisting Machinery

The Delorie Hoist Co., New York City, has just issued an attractive pamphlet describing the type of hoist which the company has developed for use on lighters and docks. Construction details are fully explained. The catalog includes a 2-page graphic description of the various component parts of the hoist which are combined as a single unit on an I-piece bedplate. The hoists are operated by internal combustion engines which, it is claimed, operate successfully on the cheaper grades of fuel such as low-grade distillate kerosene as well as gasoline, benzine, naphtha and motor spirits. It is pointed out that these engines are easy to start in the following manner: The engine is set on the outward dead center and primed with gasoline and then pulled up against compression. The magneto is next tripped which starts the engine without cranking. Two types of hoists are carried in stock, single and double drum. These are made in 3, 6, 10 and 15-horsepower sizes, with drums 6 x 12, 10 x 15, 10 x 15 and 14 x 16 inches, respectively.

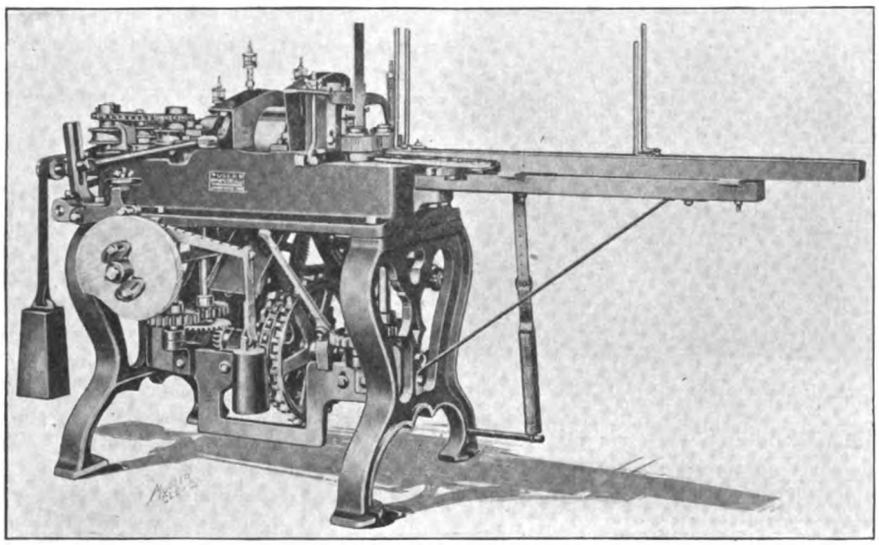
Treenail Machine

The government's wooden shipbuilding program calls for the driving of a huge number of treenails and with the object of furnishing an automatic machine to turn treenails quickly, the Ober Mfg. Co., Chagrin Falls, O., has developed the machine shown in the accompanying illustration.

The machine is entirely automatic, the operator merely keeping a pile of square stock between the guides at the front of the machine. The squares are fed automatically so that when one stick leaves the feed rolls the next stick drops into place and in turn is fed through the machine.

The turning is done by a series of knives. The first knife simply rounds the work. The finishing knives, which are automatically moved to and from the center of the die by a cam pattern, make any shape of treenail desired. The cam pattern, which is plainly shown in the illustration, is made of wood so that any style can be put on the lathe in a short time. By means of a simple adjustment the tapered end of the treenail can be changed without altering the cam pattern.

The machine, it is pointed out, will turn from 600 to 800 treenails per hour and it can also be utilized for turning other round parts, should occasion require. The regular lathe will turn work up to 1-11/16 inches in diameter and is furnished with four dies and with gearing to turn from 2 to 18 feet long.



AUTOMATIC MACHINE FOR TURNING TREENAILS

According to a report from Copenhagen, the Danish merchant fleet has 16 vessels more than 100 years old. The oldest is the CONSTANCE, registered at Nalskov, and built at Aeroe in 1723. This vessel has been in commission during the reigns of more than 10 Danish kings. She was 100 years old when the first steamboat was built.

Julius S. Holl, formerly advertising manager for the Link-Belt Co., Chicago, is now associated with the United States shipping board in the capacity of assistant head, department of shipyard volunteers. Mr. Holl's department is carrying on an extensive recruiting campaign for the purpose of obtaining 250,000 volunteer skilled workers for our shipyards. His office is at 207 National Theater building, Washington.

Riveters for Shipyards

A new catalog describing the full line of riveters handled by the Vulcan Engineering Sales Co., 1765 Elston avenue, Chicago, for the Hanna Engineering Works, has been issued. Considerable space in the catalog is devoted to descriptions of special machines adapted to shipbuilding. Many designs of riveters suitable for use in automobile plants, boiler, tank and locomotive shops also are presented. A comprehensive description of the Hanna link motion is given This motion is employed exclusively on Hanna type riveters. It is so adjusted that a predetermined and practically uniform pressure is developed on the die during approximately the last half of the piston stroke, or what amounts to about the last half inch of die travel. Therefore, it is said, only a single stroke of the die screw is necessary to take care of ordinary variations in the length of rivets, thickness of plates, size of holes, etc. The aim of the designer of the Hanna riveter was to develop a machine which would give results comparable with hydraulic riveting when using compressed air.

Leakproof Boats

"How to Make Your Boat Leakproof" is the title of a booklet recently issued by L. W. Ferdinand & Co., Boston. The booklet is interestingly written and gives full instructions for making small boats waterproof. The process consists of applying marine glue in a heated state, over which is placed a layer of canvas which in turn is heated. This causes the glue to fill the pores of the cloth, making, so it is claimed, an absolutely watertight bottom. It is pointed out that practically worthless boats, whose seams have been strained and opened, can be made as waterproof as when new. The booklet describes the material used and gives explicit instructions for its use.

Force feed lubricators are described in a 12-page booklet recently issued by the Inter-State Machine Products Co., Rochester, N. Y. The benefits of an efficient lubricator are set forth. The booklet contains a complete description of the pumping unit, check valve, clutch and driving mechanism. The booklet is well illustrated and explicit instructions for making installations are given.

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